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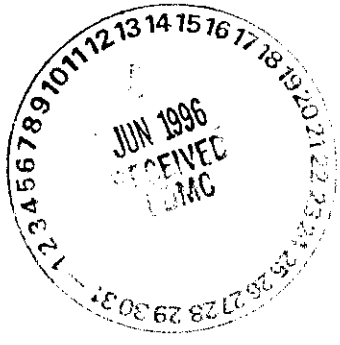
BHI-00368
Revision 0

Data Quality Objectives Workshop Results for 1301-N and 1325-N Characterization



Prepared for the U.S. Department of Energy
Office of Environmental Restoration and
Waste Management

Bechtel Hanford, Inc.
Richland, Washington

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APPENDIX

ACRONYMS

ALARA	as low as reasonably achievable
ASTM	American Society of Testing and Materials
CLP	contract laboratory program
CMS	corrective measures study
COPC	contaminants of potential concern
DOW	Description of Work
DQO	data quality objectives
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
ERC	Environmental Restoration Contractor
FY	fiscal year
GEL	Geotechnical Engineering Laboratory
HEIS	Hanford Environmental Information System
ICP	Inductively Coupled Plasma Spectrometry
LFI	limited field investigation
LWDF	liquid waste disposal facility
MCL	maximum contaminant level
QA/QC	quality assurance/quality control
QRA	qualitative risk assessment
PCB	polychlorinated biphenyl
PNNL	Pacific Northwest National Laboratories
RCRA	*Resource Conservation and Recovery Act of 1976*
RL	U.S. Department of Energy, Richland Operations Office
RLS	Radionuclide Logging System
SAFER	Streamlined Approach to Environmental Restoration
SVOC	semivolatile organic compounds
TCL	target compound list
TLD	thermoluminescent dosimeter
Tri-Party Agreement	*Hanford Federal Facility Agreement and Consent Order*
TRU	transuranic
VFW	volume fraction water
VOC	volatile organic compounds
WHC	Westinghouse Hanford Company
3-D	three-dimensional

1.0 BACKGROUND

A re-evaluation of the decisions and data needs for characterization of the 1301-N and 1325-N Liquid Waste Disposal Facilities (LWDF) in the 100-N Area at Hanford, using the data quality objective (DQO) process, was requested of the Environmental Restoration Contractor (ERC) by the U.S. Department of Energy, Richland Operations Office (RL). This document summarizes existing data, describes the 1301-N/1325-N facilities as background for the DQO process, summarizes the problems and decisions, presents the data required to address some of the decisions, and presents the sampling and analysis strategy that was agreed upon.

1.1 Purpose of DQO Process

The DQO process is intended to ensure that data collected will be of sufficient quality and quantity to support defensible decision making, while minimizing the cost of collecting duplicative or too-precise data. The steps in the DQO process documented in the *EPA Guidance for Planning for Data Collection in Support of Environmental Decision Making Using the Data Quality Objective Process* (EPA QA/G-4, 1994) are listed below.

Table 1-1 provides a correlation between the DQO steps and sections of this document. Steps 1 through 5 and Step 7 of the DQO process were the basis for planning. Steps or activities that are part of the U.S. Environmental Protection Agency (EPA) DQO processes that were not required as part of this planning are noted in the applicable DQO step. This report documents the implementation of the DQO process in support of the 1301-N and 1325-N LWDF LFI. To define the problem, historical data for the LWDFs were collected and reviewed. A summary of this review and the relevant historical data are provided in Section 2.0 and Appendix A of the report, respectively. Using the historical data, a conceptual model of the contamination associated with the LWDFs was constructed for the key contaminants of concern. The conceptual model is discussed in detail in Section 3.0. Section 4.0 of the report provides a summary of the problem using the information contained in Sections 3.0 and 4.0. Sections 5.0 through 9.0 focus on the decision-making process and detail the input, decision rules, boundaries, and uncertainty factors associated with the short- and long-term decisions to be addressed by the 1301-N and 1325-N LWDF LFI. This information is subsequently used to develop several alternative sampling and analysis strategies, which are described in Sections 10.0 through 13.0 of this report.

1.2 Safer Workshop

A previous planning workshop using the streamlined approach for environmental restoration (SAFER) was held with representatives of the EPA, Washington State Department of Ecology (Ecology), and RL between June 13 and 16, 1994. Agreements resulting from the

Table 1-1. DQO Process Steps

Step	DQO Step Description	Related Section of this Document
1	Identify the problem(s)	2, 3, and 4
2	List and prioritize the decision(s)	5
3	Identify input required to make decisions	6
4	Identify boundaries for the decisions	7
5	Identify the decision rules, logic, and criteria	8
6	Identify acceptable decision uncertainty	9
7	Generate a sampling and analysis strategy	10, 11, 12, and 13

SAFER workshop are documented in the Appendix A of the Description of Work (DOW), Draft A (DOE/RL 1994) dated August 1994. General sampling and analysis criteria were discussed in the SAFER workshop and subsequently detailed in the Draft A DOW. Historical data, cost, and exposure rates of the sampling and analysis design presented in the Draft A DOW were not adequately evaluated during the SAFER workshop. Inadequate consideration of the historical data, cost, and exposure information resulted in an expensive sampling and analysis design that likely would result in high radiation exposures to workers, and not fully address all the questions of the decision makers.

The RL requested that the ERC use the DQO process to reevaluate the decisions and data needs in support of the ongoing LFI for the 1301-N and 1325-N LWDFs. The goal of the DQO planning was a more cost-effective sampling design that decreased worker radiation exposure and met the SAFER objectives. Before the DQO meetings, Ecology and EPA provided a list of input and decisions that were a priority from their perspective. The regulators stated that, unless more information was available, Ecology and EPA would not be involved in the DQO meetings. RL and ERC technical staff met often between May 10 and June 21, 1995 to generate a conceptual model based on the historical data. After compiling data and generating the conceptual model, DQO meetings were held with Ecology, EPA, RL, and ERC on June 21 and August 22, 1995.

1.3 Facility Description

The 1301-N and 1325-N LWDFs received reactor primary coolant water, spent fuel storage basin cooling water, reactor periphery systems cooling water, reactor primary coolant loop decontamination and rinse solution, and miscellaneous drainage from reactor support facilities. The waste contained radionuclides. The 1301-N LWDF consists of a crib and trench. This facility operated between 1965 and 1985. The 1301-N LWDF operated for 20 years with an average flow rate of 1,800 gpm. The crib area, which is covered with large rock, is 88 m (290 ft)

long by 38 m (125 ft) wide by ~ 3.1 m (~10 ft) deep, and the trench area, which is covered with concrete, is 488 m (1,600 ft) by 15 m (50 ft) by 3.7 m (12 ft) deep.

The 1325-N LWDF operated from 1983 to 1990 with an average flow of 450 gpm. The 1325-N LWDF consists of a crib and a trench extension. The 1325-N crib is 76 m (250 ft) long by 73 m (240 ft) wide by 1.7 m (5.6 ft) deep. The 1325-N trench is 914 m (3,000 ft) long by 17 m (55 ft) wide by 2.1 m (7 ft) deep. Only a short segment of the trench near the crib was used. The remainder of the trench was blocked from receiving water. The trench and crib are covered with concrete.

1.4 Overview of Existing Data

Information relating to the 1301-N and 1325-N LWDFs compiled in the DQO workshop included historical process documents, monitoring data, characterization study reports, and personal communication with operations and environmental personnel. The existing monitoring and characterization data were compiled in an electronic database. The database was reviewed for entry errors and obvious data quality assurance/quality control (QA/QC) problems. To facilitate the review and evaluation of the large volume of data, summary tables were prepared. The summary tables included the following:

- Estimated amounts of hazardous waste discharged to the 1301-N and 1325-N LWDFs
- 1301-N/1325-N LWDFs contaminant loading data
- 1301-N trench and 1325-N crib sediment concentrations
- Soil concentrations in cross section for cobalt-60, cesium-137, and strontium-90 from the cribs/trenches to the river.

Decay calculations and details of the original data used to prepare summary tables are presented in Appendix A-1.

The volume of published and unpublished historical data relating to the LWDFs was found to be extremely large. The data were reviewed and selected for compilation based on relevance to contaminant migration, and radionuclide and dangerous waste priorities previously discussed. The decision makers agreed with the technical staff on this approach.

Additional unpublished data relating to the 1301-N/1325-N LWDFs not used in the DQO workshop and not presented in Appendix A-1 will be compiled during the LFI report scheduled for preparation after the characterization effort. These data may include surface soil samples, air monitoring data, dose rate measurements, thermoluminescent dosimeter (TLD) monitoring data, effluent monitoring data, laboratory experiments of chemical and physical properties, vegetation samples, and bioassay results. Groundwater monitoring data and monitoring data from

N-Springs and the Columbia River were reviewed in recent DQO planning process for the 100-N pump-and-treat system by the technical team assigned to this project.

1.5 Overview of Problems and Decisions

An overview of the problems and decisions is presented to allow the reader to place in context the review of the existing data in Section 2.0 and the conceptual model in Section 3.0. A more detailed discussion of problems and decisions is presented in Sections 4.0 and 5.0, respectively.

1.5.1 Current Conditions

The current maximum contaminant level in drinking water is established at 8 pCi/L for strontium-90. A pump-and-treat system to remove strontium-90 from the groundwater in the area between the 1301-N LWDF and the Columbia River is underway as part of the Expedited Response Action. Groundwater wells near the river indicate strontium-90 concentrations that range from nondetects to ~4,000 pCi/L in 1994 per the DQO results documented in the *N-Springs Expedited Response Action (ERA) Performance Monitoring Plan* (BHI 1995). Strontium-90 results predominantly are below the MCL.

Surface radioactivity monitoring of the 1301-N and 1325-N LWDFs indicates significant exposure levels that would exceed any risk levels allowed by EPA. No characterization of the vadose zone directly under the cribs and trenches has been performed. Strontium-90 results from soil borings from wells between the 1301-N LWDF and the Columbia River show concentrations ranging from nondetects to 50 pCi/g. All parties agree that concentrations of strontium-90 and other radionuclides directly under the LWDFs are probably much higher than observed at the boreholes between the 1301-N LWDF and the river.

Based on data surrounding the LWDFs, the previous operational water table was much higher than today's water table. Decision makers agreed that nuclides (strontium-90, cesium-137, cobalt-60, and plutonium-239/240) were the primary contaminants of potential concern (COPC) and dangerous waste metals (lead, cadmium, chromium, and nickel) were secondary contaminants.

1.5.2 Problems and Decisions

The problems and associated decisions are listed in Table 1-2. This data collection effort is focused to problem number 1. While data should be usable for addressing both problems, the data from this characterization effort is focused on the initial problem.

Table 1-2. Summary of Problems and Decisions

Problems	Decisions
1. The immediate problem is whether high concentrations of radionuclides under the cribs and trenches are likely to migrate downward to groundwater and out to the river increasing concentrations of strontium-90 or other nuclides of concern.	Determine if immediate action is required to protect groundwater. This decision will be based on data pertaining to the current contaminant inventory in the vadose zone under the cribs and trenches, vadose zone moisture content, current depth to groundwater, contaminant soil partition coefficients, and other parameters that will permit the assessment of migration potential.
2. The radionuclide concentration at the surface of the LWDFs is high and currently poses a human health risk. The long-term problem is whether the high concentrations of contaminants will migrate to groundwater and ultimately migrate to the Columbia River increasing risk. A second problem is what actions will be required to minimize risk.	Long-term decisions include: 1) Determine if soil remediation is required and when remediation should be performed (if required). 2) Determine applicable remedial alternatives, the timing of remediation, and the volume and concentration of the material under the cribs and trenches requiring treatment or removal. 3) Determine the waste disposal strategy if either remove/dispose or remove/treat/dispose is chosen as the remedial alternative. All parties agreed that removal of the contaminated soil is a potential remedial alternative. The top layers of rock and soil from Zone 1 (see the conceptual models in Section 3.0) are the most likely targets for removal. The timing of any removal action will be determined in the corrective measures study (CMS) evaluation of the remedial alternatives using the data collected for the LFI.

2.0 DETAILED REVIEW OF EXISTING DATA

The DQO documents EPA G-4 and EPA/540/G-93/071 indicate that historical data related to the project should be summarized. This summary allows an understanding of current site conditions as well as development of a conceptual model of the extent and probable fate of contaminants. The nuclide inventory, dangerous waste permit contaminants and inventory, sediment sampling results for the cribs and trenches, and data pertaining to soil boring and groundwater between the cribs and the river were used to formulate a conceptual model for the DQO. The data also were used to assess current site conditions to formulate the problem statements. This section provides a summary of the information used to construct the conceptual model and clarify the problem. The application of the data to the decision-making process is provided in Section 6.0. Detailed tables of supporting data are provided in Appendix A-1.

2.1 Cumulative Inventory

Summaries of annual and cumulative releases of cobalt-60, cesium-137, strontium-90, and plutonium-239/240 discharged to the 1301-N and 1325-N LWDFs are presented in Table A1-9 of Appendix A-1. This table shows that significant quantities of cobalt-60, cesium-137, strontium-90, and lesser amounts of plutonium-239/240 were discharged to the facilities. The cumulative releases for these radionuclides are taken from Tables 2 and 3 of Diediker and Hall (1985). No other document for the 100-N Area summarizes the cumulative releases to the LWDFs. For 1985 to the present, each year's release has been taken from the annual reports, and a new cumulative release table for each radionuclide has been calculated using the same formula given in Diediker and Hall (1985). All releases in this table have been decayed to 1995 using the following formula:

$$C_{1995} = C_{Year\ of\ Release} \cdot e^{\left\{\frac{-0.693}{Half\text{-}Life(y)} \cdot (1995 - (Year\ of\ Release))\right\}}$$

It appears data from 1964 to 1966 were extrapolated from the 1967 and 1968 releases. Because of the extrapolation, the inventory reported from 1964 to 1966 is uncertain.

2.2 Contaminant Inventory from RCRA Part A Permit

The *Resource Conservation and Recovery Act of 1976* (RCRA) Part A permit, Revision 5 lists the estimated total pounds per year of discharge by waste classification when the facilities were operational. Table A1-10 of Appendix A-1 provides estimated weights of acetone, corrosive, cadmium, lead, mercury, hydrazine, carcinogens, and toxins discharged to the 1301-N and

1325-N LWDFs. Besides these discharges, sodium dichromate was discharged to the 1301-N LWDF. This information can be used to examine the cribs and trenches for dangerous waste and to establish the COPCs for characterization.

2.3 Sediment Sampling

Sediment samples were collected through access hatches located in the cement panels covering the 1301-N trench and 1325-N crib. Figure A1-1 of Appendix A-1 illustrates the sediment sampling hatch locations. Metal or plastic scoops were used to dip into the top of the sediment through the existing access hatches. Little sediment was available for collection because of the rocks and water in the bottom of the LWDFs. Low sediment volume, in addition to working in a high dose rate area, made collecting samples difficult. Sediment samples were not collected in the 1301-N crib because it is covered with boulders; sediments were not collected in the 1325-N trench because only one-third of the trench was used.

For each sediment sample at each location, cesium-137, cobalt-60, strontium-90, and plutonium-239/240 was averaged and graphed by location (Figures A1-2 and A1-3). Sediment data for the 1301-N LWDF from 1980 to 1985 and 1325-N crib data from 1985 to 1987 were averaged at each sampling location. All data were decayed to May 30, 1995.

The following trends were observed in the 1301-N LWDF. Cobalt-60 and strontium-90 generally decreased from the 1301-N trench away from the crib. Two cesium-137 results from two years (1983 with a concentration of 83μCi/g and 1984 with 3μCi/g) were much higher than the remaining data. Plutonium was much higher at TS-04 in 1982 at 2.8 μCi/g, while other concentrations ranged from 3 nCi/g to 660 nCi/g . Table A1-13 presents the 1301-N LWDF sediment data.

Both cobalt-60 and cesium-137 were consistently high at CS-1 in the 1325-N crib. Cobalt-60 ranged from 9.1 μCi/g to 0.82 μCi/g. Strontium-90 and plutonium-239/240 were significantly higher at CS-7 and CS-8 in 1325-N crib. No obvious factors could be identified which would have produced higher concentrations of the radionuclides at these particular sampling localities. Table A1-14 presents the 1325-N sediment data.

2.4 Soil Borings and Cross Sections

Digitized maps were created of the surface topography, the top of the Ringold gravel Unit E, the top of the Ringold Mud Unit, the current water table, and the historical high water table. Once these digitized maps were created, a geologic cross section showing the relationships between the geologic units, the high water table, the current water table, and the contaminant concentrations within the 100-N Area was created. The digitized grid of each surface was created by importing the scatter data (well locations, geologically interpreted contour lines, and aerial photography)

into the program Earth Vision[1]. Earth Vision interpolates (using a minimum tension algorithm) the scatter data to a digitized grid in two-dimensional space. The scattered data used to create these grids originated from the following sources.

Surface Topography:	Adapted from the AutoCad DXF files from the 1989 to 1990 fly over of the site. The 2.5 m (8.2 ft) contour lines from these files were used to create this map.
Hanford-Ringold Contact:	Adapted from Figure 3 of Knepp et al. 1995. The contour lines and well elevations from this figure, along with the new data from wells 199-N-103A, 199-N-104A, and 199-N-105A were used to create this map.
Ringold Gravel-Mud Contact:	Adapted from Figure 2-5 of Hartman and Lindsey 1993 by adding new data from wells 199-N-91, 199-N-92, 199-N-93, 199-N-94, 199-N-95, 199-N-96, 199-N-97, 199-N-99, 199-N-103A, 199-N-104A, and 199-N-105A.
Current Water Table:	Adapted from the Hanford Environmental Information System (HEIS) database query for December 1994 water level measurements.
Operational Water Table:	Adapted from the HEIS database query for all water level measurements during the operational history of the LWDFs. The most complete set of water level measurements came from 1969, which was used for the three-dimensional (3-D) representation of the 100-N Area. It was later modified by taking only the maximum water level measurement during operations.

Because the grids are created by the computer, they are checked manually using several different methods. The first method is to confirm that the grids honor all the scatter data points. If the grid honors the data points, it is checked to verify the contouring algorithm does not create any artifacts (i.e., making features such as depressions or highs in the surfaces that are not supported by the scatter data). Finally, a series of layers in 3-D space are built that represent the site. This last step is to authenticate that all of the crosscutting relationships between the geologic units, as well as the water table, are correct. This is done by merging the different layers and visually inspecting the 3-D site representation. Once the 3-D representation of the site is accurate, it is manipulated to extract cross sections, place the contaminants in the appropriate layers, and estimate volumes of contaminant mass.

[1]Earth Vision is a trademark of Dynamic Graphics, Inc.

Figure A1-4 shows the location of the two cross sections discussed in this section. Figures A1-5 through A1-10 show concentrations of radionuclides in the vadose zone downgradient from the 1301-N/1325-N LWDFs to the Columbia River. These figures show negligible concentrations (decayed to May 1995) of cobalt-60 and cesium-137 in the old groundwater mound region (12.2 to 21.3 m [40 to 70 ft]). However, strontium-90 is present in pCi/g concentrations in downgradient soils once saturated with effluent originating from the facilities (now stranded in the vadose zone region once saturated by the operational groundwater mound).

2.5 Personnel Interviews

A Westinghouse Hanford Company (WHC) operator who collected the sediment samples at the 1325-N LWDFs was present at a DQO meeting and provided the following insight.

- Sampling ceased in 1987 because of as low as reasonably achievable (ALARA) and dose rate concerns.
- The 1325-N trench was added after three months of crib operation because low percolation rates resulted in flooding of the 1325-N crib.
- Flow was diverted back to 1301-N crib when flooding occurred at the 1325-N crib; therefore, 1325-N crib received only 23% of total effluent volume from 1983 to 1985.
- Sediment sample collection and analysis for metals were performed using inadequate protocols by current requirements. Consequently, the quality of the sample data is uncertain, and therefore should not be the only data used for decision-making purposes.
- The WHC/United Nuclear Corporation effluent monitoring reports are good sources of data.
- "Blue books" contain details about 1301-N and 1325-N LWDF operations.
- Rumors of sludge dumping and truck burials were unsubstantiated.
- No effluent releases to 1301-N occurred after 1985.

Another WHC employee was interviewed outside the DQO workshop and provided information on the 1301-N crib design. The employee explained that the 1301-N crib was excavated to an elevation of 137 m (450 ft) with a berm rising to 139 m (455 ft). Then boulders were added, nearly filling the rectangular basin. A 1.2 m (4 ft) depth is the best estimate for the 1301-N crib rock depth, with much more rock immediately surrounding the trough. An additional layer of boulders was added in the early 1980's to cover surface contamination on the rocks caused by periodic flooding with waste water from N Reactor decontamination flushes. The new boulders added about 0.61 to 0.91 m (2 to 3 ft) of rock from the head end of the crib near the trough to

about 31 m (100 ft) of the length of the crib. From August to September 1988, the entire crib was covered with smaller rock to add an additional depth of 1.2 to 1.5 m (4 to 5 ft). An original drawing showing some of this detail is H-1-3-589.

The DQO group asked the operator why the sodium dichromate was used and the time of use. During N Reactor operations in 1968, 1969, and 1970, a few aluminum process tubes were used for the production of tritium. Sodium dichromate was used in the primary coolant system to inhibit corrosion of aluminum until the early 1970's. Because the 1325-N LWDF was built in the early 1980's, sodium dichromate was discharged to the 1301-N LWDF only. This indicates that chromium is not likely to be a COPC in the 1325-N LWDF.

2.6 Summary of Existing Data

Table 2-1 summarizes the data from this section and presents its use. The data provide the basis for the current site condition and problem statements of Sections 1.0 and 4.0.

Table 2-1. Summary of Historical Data and Data Uses
(Page 1 of 2)

Information Type	Information/Data Summary	Use of Information
Cumulative Inventory	11,000 Ci released to soil from 1964 to 1984 in the 1301-N/1325-N LWDFs. Data from 1964 to 1966 are uncertain. Total releases after 1984 were not calculated due to insufficient radionuclide-specific inventory data subsequent to 1984.	Confirm amounts and types of nuclides contributed. Used in modeling with partition coefficients and volume of water to estimate amount of material in vadose zone.
Dangerous Waste Inventory from RCRA Part A	The revised LFI COPC list may include cadmium, chromium, lead, and nickel. Because of the volatility acetone, it did not remain as a COPC. Mercury was removed from the COPC list due to sample holding time problems and associated radiological constraints. Chromium is only associated with the 1301-N LWDF. Hydrazine was removed from the LFI COPC list due to its high solubility in water and volatility and it was not detected in the effluent discharged to the LWDFs.	Assist in prioritizing dangerous waste COPCs. Historical data clearly indicates nuclides are higher priority, however, RCRA does not regulate radionuclides.
Sediment Sampling	The concentration of strontium-90 is in the nCi/g range on the near-surface of the facilities. Concentrations of cobalt-60 and cesium-137 are in the µCi/g range in the near-surface of the facilities. Plutonium ranged from µCi/g to nCi/g on the surface of the facilities. Three samples from one year exceeded the transuranic level in the 1301-N trench. One sample one year exceeded the transuranic level in the 1325-N crib.	The initial data are used in the conceptual model to assess potential amounts of contaminants in the near-surface. The data are compared to levels of these nuclides in borings outside the footprint of the crib/trenches to assess migration away from the facilities.

Table 2-1. Summary of Historical Data and Data Uses
(Page 2 of 2)

Information Type	Information/Data Summary	Use of Information
Soil Borings and Cross Section	Strontium-90 concentrations in soil borings near the Columbia River ranged from nondetects to 50 pCi/g at 199-N-94A well. Cobalt-60 and cesium-137 concentrations in borings near the river ranged from nondetects to fractions of a pCi/g. Soil boring profiles outside the facility footprint indicated higher strontium-90 and cobalt-60 concentrations present in the soil between the operational water table (high water table) and the present water table.	The strontium-90 appears to migrate from the facilities more than cesium-137 and cobalt-60. Levels of strontium are still in the 50-pCi/g levels at the river. Soil boring profiles show that cobalt-60 and cesium-137 decrease to nondetects and fractions of a pCi/g 61 m (200 ft) or more from the facilities The nuclides appear to remain in soils once saturated with effluent originating from the facilities. The data were used to generate a conceptual model of concentration for the nuclides as shown in Table 3-1.

3.0 CONCEPTUAL MODEL

3.1 Purpose of Conceptual Model

The conceptual model helps to resolve the problem and understand the amount and type of data to be needed. The site conceptual model was developed by using the following:

- Building the conceptual model based on the data presented in Section 2.0 and Appendix A-1
- Indicating areas or zones that have no supporting data
- Preparing a conceptual representation in the area with no data.

3.2 Model of Contaminants per Zone

A generic model for the LWDFs was developed for cobalt-60, cesium-137, and strontium-90. A vertical and horizontal profile of the cribs and trenches was generated with the contaminants divided by 1) concentration, 2) surface soil, 3) vadose zone to include the operational water table, and 4) the current groundwater table. Although plutonium is also a contaminant of concern, existing data do not indicate that this contaminant has migrated to any significant extent beyond the 1301-N and 1325-N LWDF boundaries. As a result, no conceptualization is presented for plutonium.

3.3 Description of Zones and Concentrations per Zone

A site conceptual model is needed to permit development of a clear problem statement and to understand how much data are required to make decisions relative to solving the problem. A site conceptual model for the 1301-N and 1325-N LWDFs was developed by:

- Compiling and interpreting existing data associated with the 1301-N and 1325-N LWDFs
- Identifying data gaps
- Preparing a graphical conceptual representation of the 1301-N and 1325-N LWDFs and contaminant distribution in the subsurface, and indicating those areas or zones with no data.

Each zone is described and illustrated by analyte in Figures 3-1, 3-2, and 3-3. While the contaminants vary, the zone boundaries do not change. The zone descriptions are presented with

summary information by contaminant. The figures show the measured and assumed concentrations by zone for cobalt-60, cesium-137, and strontium-90.

Zone 1 consists of the cobble and soil material in and immediately under the 1301-N and 1325-N LWDFs. The depth from surface for this zone is dependent on which facility the model is applied to. Generally, the bottom of Zone 1 is located 1.5 m (5 ft) beneath the bottom of the facility. The concentrations of the contaminants of concern will be the greatest in this zone. This is supported by the existing data available for the 1301-N and 1325-N LWDFs and the observed subsurface distribution of these contaminants at other 100 Area facilities, which exhibited waste disposal practices and design similar to that of the 1301-N and 1325-N LWDFs. The horizontal boundary of Zone 1 is assumed to be the plan view projection of the facility boundary. All three contaminants have measured concentrations in this zone.

Zone 2 extends from approximately 1.5 m (5 ft) below the crib/trench to the capillary fringe above the operations-era groundwater table. During operation of the 1301-N and 1325-N LWDFs, the water table increased an average of 9 m (30 ft), due to groundwater mounding beneath the facilities. Since the termination of effluent disposal to the 1301-N and 1325-N LWDFs, the water table has subsided to near static conditions. Soil data from groundwater wells in the vicinity of the LWDFs indicate that significant concentrations of strontium-90 remain stranded in the vadose zone as a result of the declining water table. Lateral spreading of the infiltrating waste water is not well defined for Zone 2. Since no direct measurements exist beneath the crib/trenches at this depth, contaminant concentrations in Zone 2 are estimated.

Zone 3a has an upper boundary of the old capillary fringe including the region between the operations-era water table and the current water table. The horizontal boundaries of Zone 3a are based on the plan view facility boundaries. This horizontal boundary is estimated and extends outside the plan view facility boundaries slightly.

Zone 3b is the unconfined aquifer saturated soils found directly beneath the 1301-N and 1325-N LWDFs. Concentrations are estimated based on groundwater data collected from monitoring wells near the 1301-N and 1325-N LWDFs.

Zone 4a is the drained vadose zone located between the operations-era water table and the current water table outside the area directly beneath the 1301-N and 1325-N LWDFs. Zone 4a encompasses the region from the 1301-N and 1325-N LWDF boundaries to the Columbia River. Measured concentrations exist for strontium-90, cesium-137, and cobalt-60 in this zone.

Zone 4b is the unconfined aquifer saturated soils found outside the boundaries of the 1301-N and 1325-N LWDFs. Zone 4b encompasses the region from the 1301-N and 1325-N LWDFs boundaries to the Columbia River. Measured concentrations exist for the groundwater and soils in the groundwater between the 1301-N and 1325-N LWDFs and the Columbia River. The N-Springs pump-and-treat program is remediating strontium-90-contaminated groundwater in this region.

Table 3-1 outlines the general concentration levels by analyte and zone with measured versus estimated or assumed concentrations. Figures A1-5 and A1-6 show the measured concentrations in Zone 4a and 4b. Figures A1-2 and A1-3 show the measured concentrations in Zone 1. The assumed or estimated concentrations are based on speciation, partition coefficients from similar soil, inventory, and analogous site contaminant migration data.

3.4 Methods Used to Assess Conceptual Model

Several methods were used to assess radionuclide distribution in Zones 1, 2, 3, and 4. These methods included the following:

- Interpretation of historical radiological concentrations in trench and crib sediments
- Analysis of the form and speciation of radiological contaminants
- Concentration estimates based on a current surface radiological surveys
- Inventory balance
- Contaminant distribution data from analogous 100 Areas sites.

3.4.1 Interpretation of Historical Sediment Data

Sediments from the 1301-N trench and 1325-N crib were collected for radiological analysis at various times during the operation of these facilities. Sediment data from the 1301-N trench were collected from 1975 to 1985, while data from the 1325-N crib were collected from 1985 to 1987. Access to the 1301-N trench for sediment sampling was facilitated by nine access holes (identified TS-01 through TS-09) located in the concrete cover along the axis of the trench. Sampling access at the 1325-N crib was gained through 12 manholes (called CS-01 through CS-12) located in the concrete crib cover.

Historical sediment data are presented in Section 2.3 and in Tables A1-13, A1-14, and A1-15. Based on values decayed to 1995, the following relative order-of-magnitude concentrations for cobalt-60, cesium-137, strontium-90, and plutonium-239/240 in Zone 1 are projected:

cobalt-60	~ μCi/g
cesium-137	~ μCi/g
strontium-90	~ nCi/g
plutonium-239/240	~ nCi/g

Table 3-1. Conceptual Concentration Model Summary

Zone	Strontium-90	Cesium-137	Cobalt-60
1	nCi/g range M	µCi/g range M	µCi/g range M
2	nCi/g range A	nCi/g range A	nCi/g range A
3a	pCi/g range A	pCi/g range A	pCi/g range A
3b	pCi/g range A	pCi/g range A	pCi/g range A
4a	low pCi/g range M	low pCi/g range M	low pCi/g range M
4b	low pCi/g range M	low pCi/g range M	low pCi/g range M
M = measured, A = assumed			

3.4.2 Form and Speciation of Contaminants

A major factor controlling the subsurface distribution and mobility of radionuclides is the physical state (form) and speciation of the contaminants. Table 3-2 shows the relative distribution of particulate, cationic, and anionic forms of radionuclides measured in N Reactor effluents discharged to the 1301-N and 1325-N LWDFs. Overall, the cationic and particulate forms of the contaminants are expected to have low mobility in the subsurface. In addition, contaminants exhibiting large soil distribution coefficients (K_d) are expected to be highly reactive with the soil and absorb quite readily. As a result, those contaminants that speciate primarily as cations, exhibit a high K_d, and/or form particulate phases are expected to concentrate in Zone 1. Therefore, high concentrations of cobalt-60, cesium-137, and plutonium-239/240 should be confined to Zone 1. High concentrations of strontium-90 will be found in Zone 1, although significant concentrations of this contaminant also will be found throughout the vadose zone (Zones 2, 3, and 4) due to its moderate K_d.

3.4.3 Concentration Estimates from Surface Radiological Surveys

Radiological surveys are used to estimate the near-surface concentration of cobalt-60. Dose rates up to 350 mrem/hr at 0.9 m (3 ft) above the concrete panels at the 1301-N trench have been measured during recent surface radiological surveys. Using the radiation shielding program MICROSHIELD, conversion of dose rate measurements to near-surface concentrations shows that µCi/g levels of cobalt-60 are present in Zone 1.

3.4.4 Activity Balance

Estimates of activity distribution in the subsurface can be made using the historical radionuclide inventory, near-surface sediment sampling data, facility dimensions, and assumptions concerning the bulk density of soils beneath the facility. These calculations indicate that the entire

Table 3-2. Form and Speciation of Select Radiological Contaminants of Concern

Isotope	Particulate	Cationic	Anionic	K_d
Cobalt-60	40 to 98%	2 to 60%	<1%	~3500
Cesium-137	1 to 5%	85 to 100%	<1.4%	2380±1000
Plutonium-239/240	Precipitate at pH>2	N/A	N/A	100 - 2000
Strontium-90	N/A	N/A	N/A	~10

Sources:
Closure and Post-Closure Plan for the 1301-N and 1325-N LWDF (UNI 3533)
Radionuclide Migration in Groundwater, Annual Progress Report for fiscal year (FY) 83 (NUREG/CR-3712)
Radionuclide Migration in Groundwater, Annual Progress Report for FY 81 (NUREG/CR-4030)
Hanford Waste-Form and Sediment Interaction (PNL-7297)
Technical Reevaluation of the N-Springs Barrier Wall (BHI-00185)
N/A = not available

documented inventory of cobalt-60, cesium-137, and plutonium-239/240 can be accounted for in the upper 0.76 m (2.5 ft) of Zone 1 for the 1301-N LWDF. Most of the strontium-90 is likely to be distributed throughout Zone 1 and the upper portion of Zone 2. Graphical examples of these calculations are provided in Figures 3-4 through 3-7.

3.4.5 Contaminant Distribution Data From Analogous 100 Areas Sites

Soil radiochemistry data collected during various 100 Areas LFI were examined to determine the characteristic vertical distribution of cesium-137, cobalt-60, plutonium-239/240, and strontium-90 in the soil column beneath facilities that had received reactor cooling water as a primary effluent. These data were used to qualitatively assess the likely vertical extent and distribution of these contaminants in the soil column beneath the 1301-N/1325-N LWDFs. The 100 Areas facilities thought to be most comparable with the 1301-N/1325-N LWDFs include those that received large volumes of reactor cooling water as a primary waste.

Two types of 100 Areas facilities fulfill this requirement. These facilities are unlined, process effluent disposal trenches and cribs, and cement-lined retention basins. Process effluent disposal trenches and cribs received large volumes of reactor coolant effluent resulting from retention basin overflow and diversion of reactor coolant during retention basin cleaning and maintenance. Retention basins received reactor coolant during normal reactor operations. Although the retention basins were cement-lined, most (if not all) of these facilities leaked during their period of active use, contaminating the soil column. Process effluent trenches examined include the 116-K-1 crib, 116-K-2 trench, 116-DR-1 trench, and the 116-F-2 trench. Retention basins examined include the 116-DR-9 and 116-F-14 trenches.

Figure 3-8 illustrates the distribution of contaminants with depth for the 116-DR-1 and 116-K-2 process effluent trenches and the 116-F-2 Retention Basin. These figures illustrate that the highest concentration of contaminants is located immediately below the suspected base of each facility, and that concentrations logarithmically decrease with depth for all contaminants. Relative contaminant distribution trends beneath the 1301-N and 1325-LWDFs will be similar to those observed at these 100 Areas sites.

Figure 3-1. Conceptual Model for Cobalt-60.

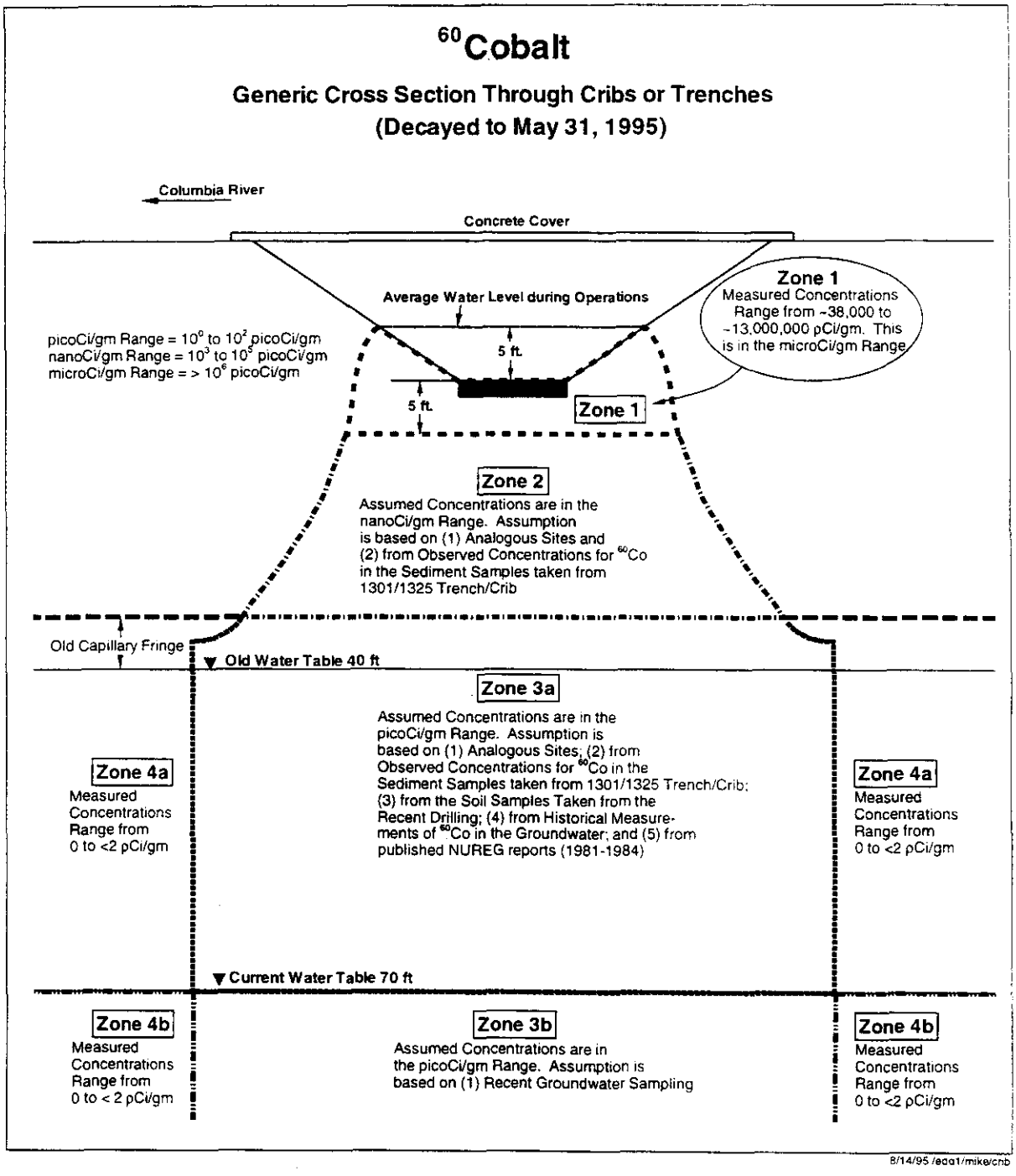


Figure 3-2. Conceptual Model for Cesium-137.

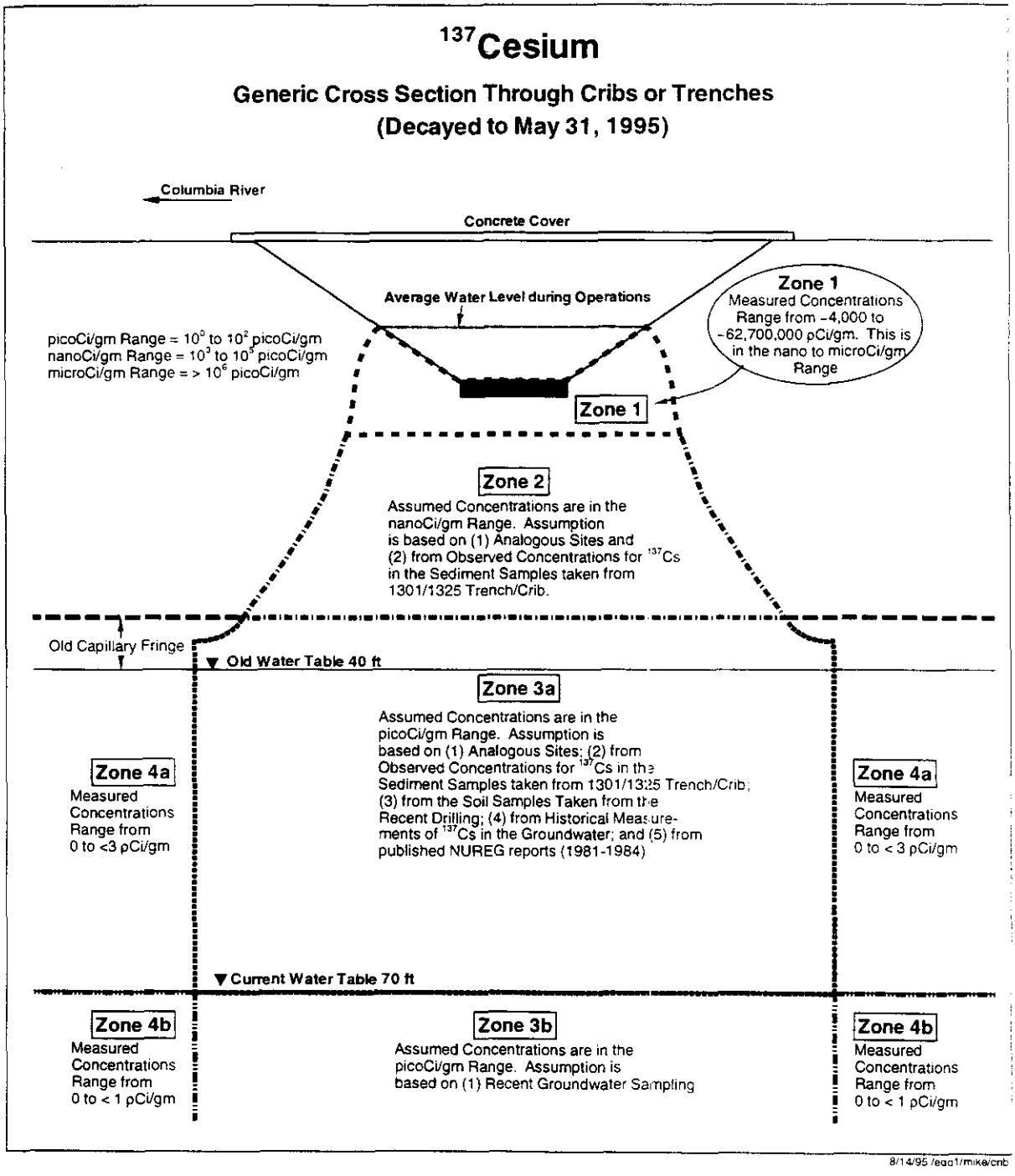


Figure 3-3. Conceptual Model for Strontium-90.

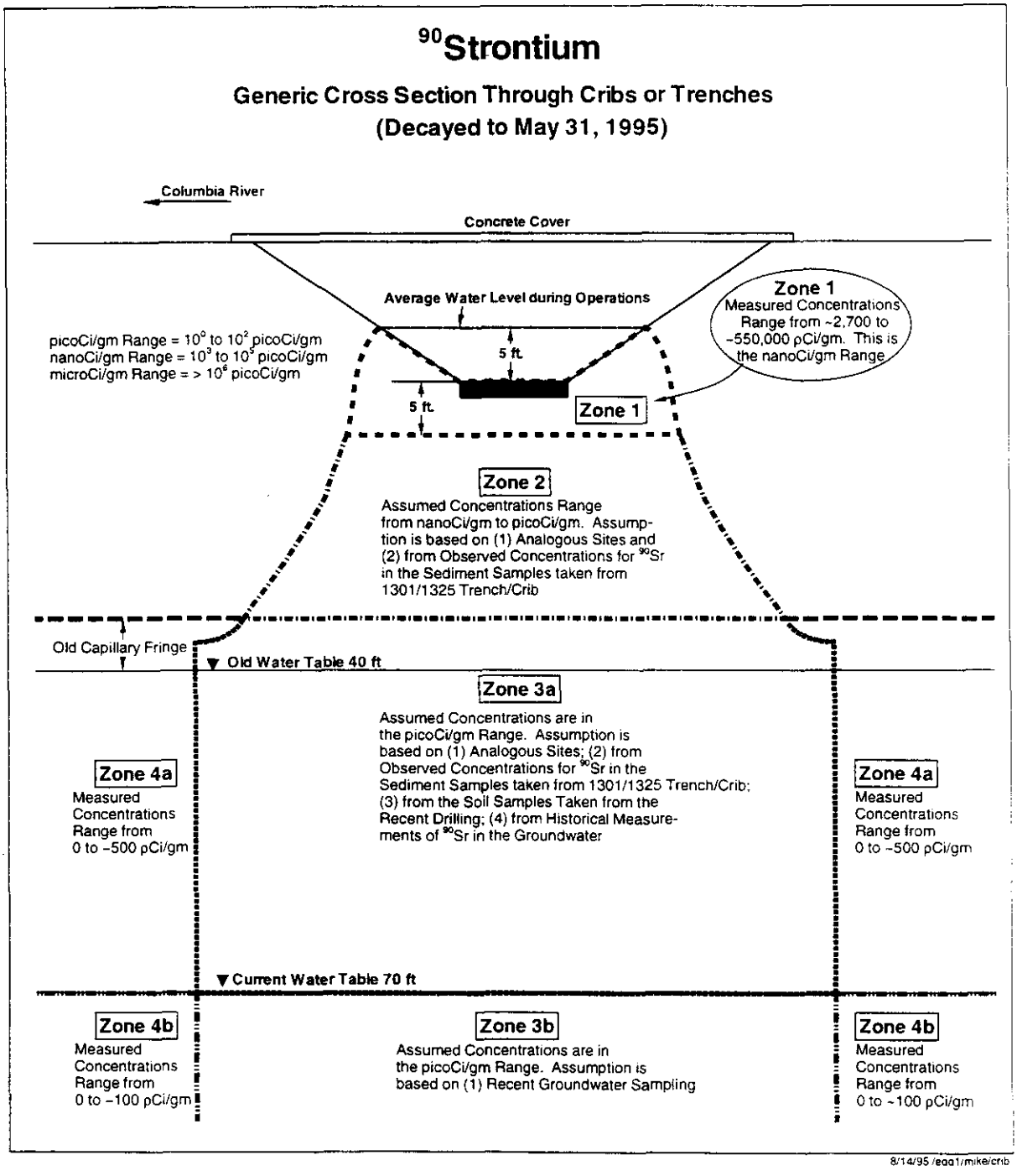


Figure 3-4. Mass Balance Calculation for Cobalt-60.

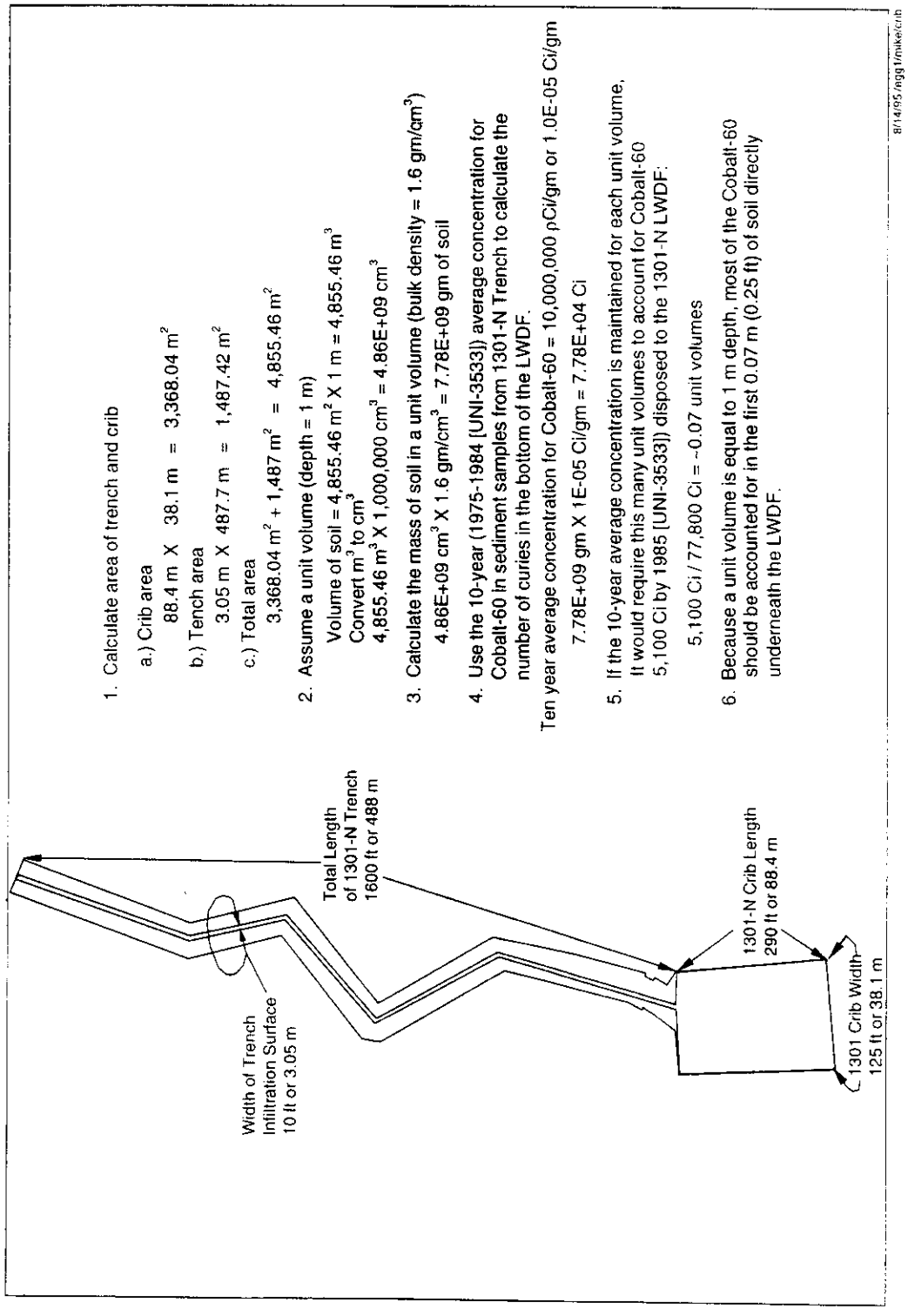


Figure 3-5. Mass Balance Calculation for Cesium-137.

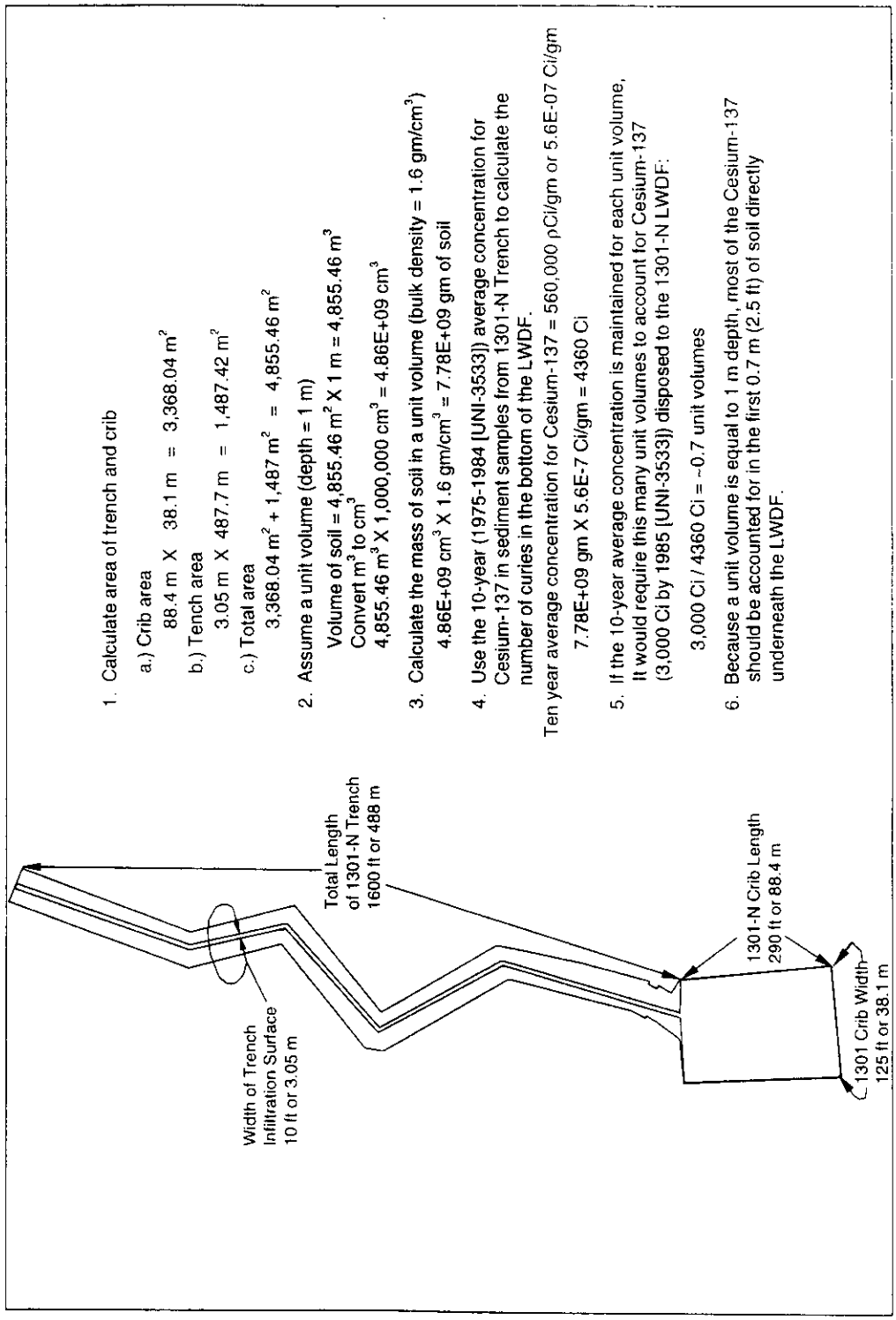


Figure 3-6. Mass Balance Calculation for Plutonium-239/240.

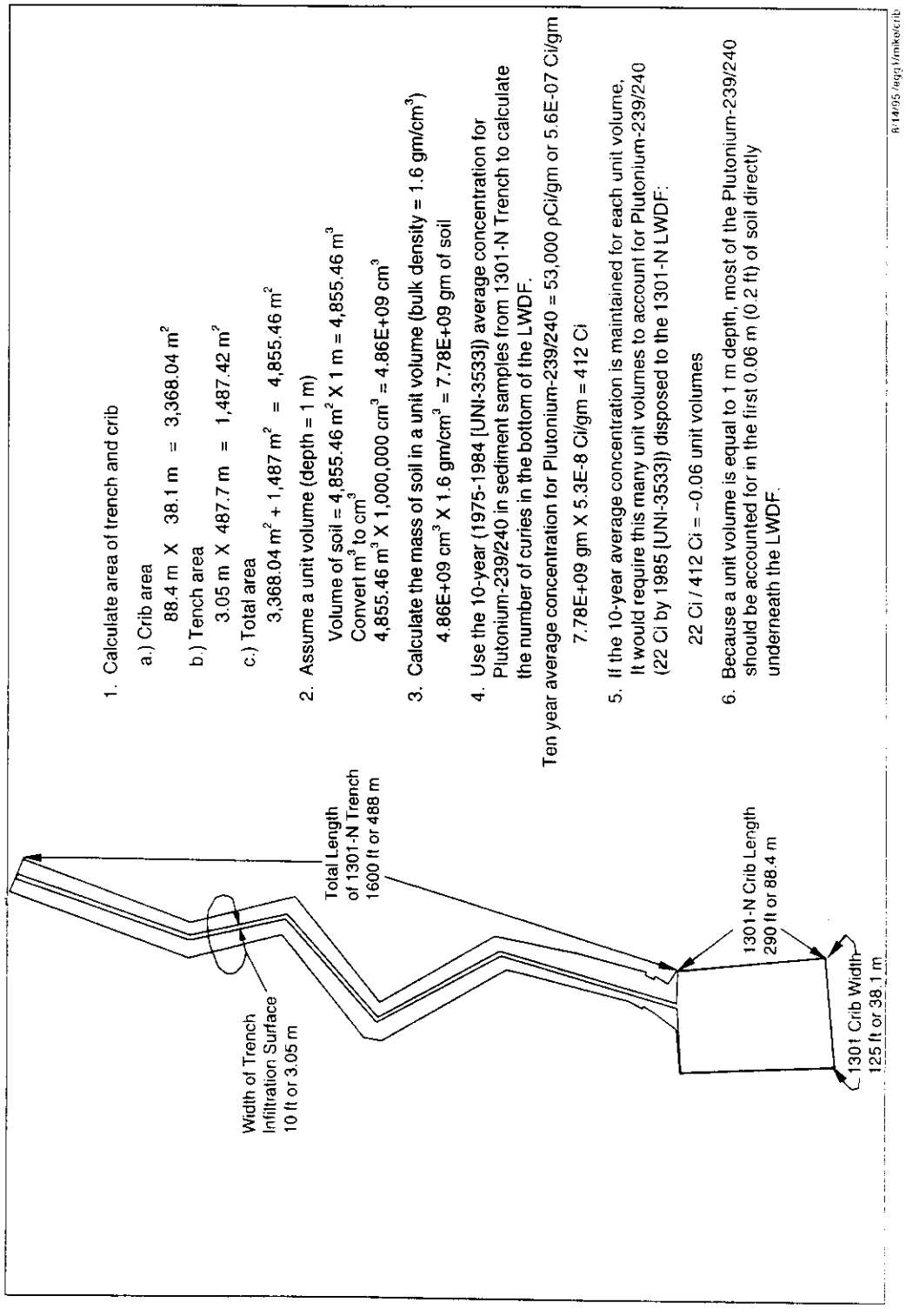


Figure 3-7. Mass Balance Calculation for Strontium-90.

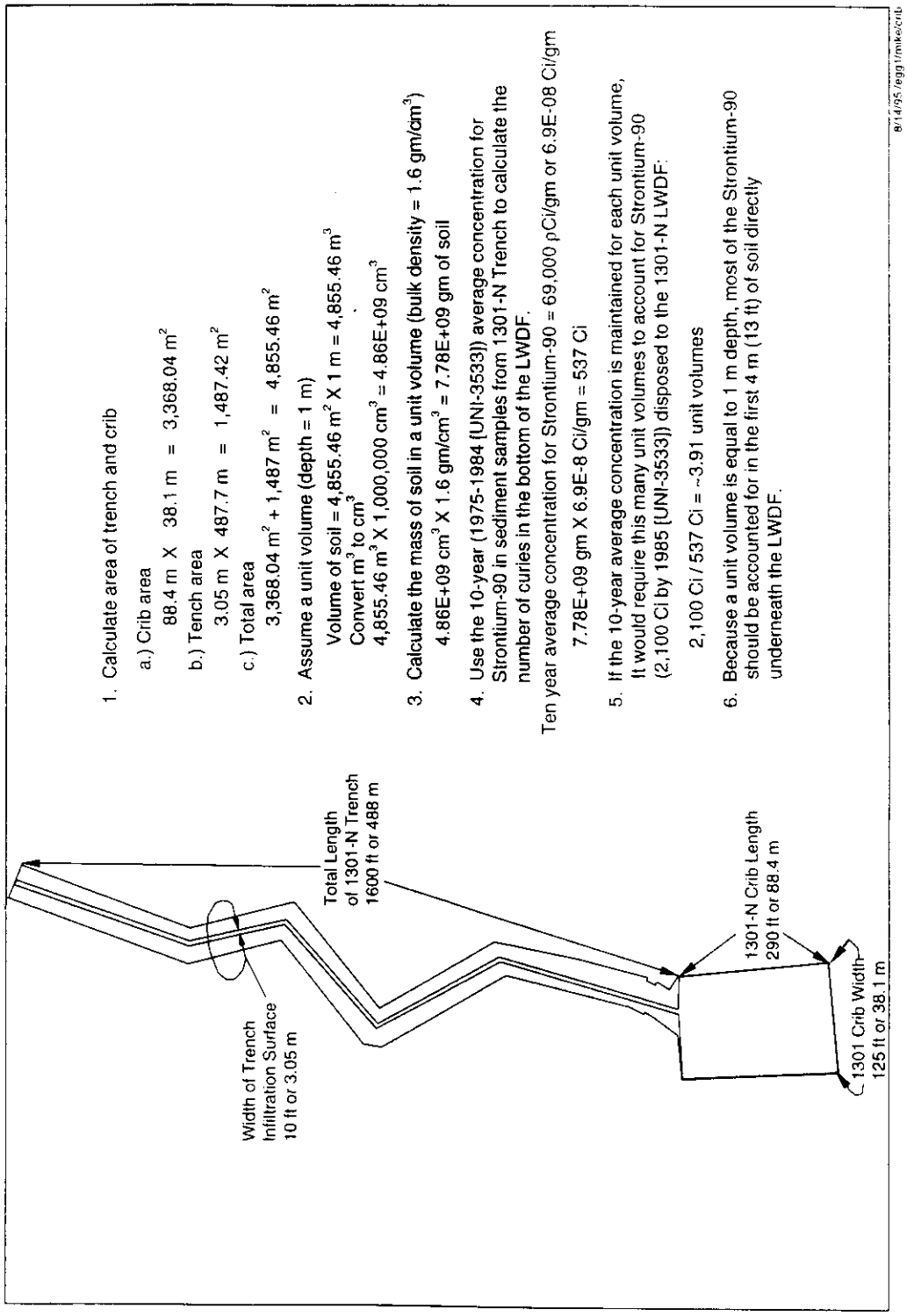
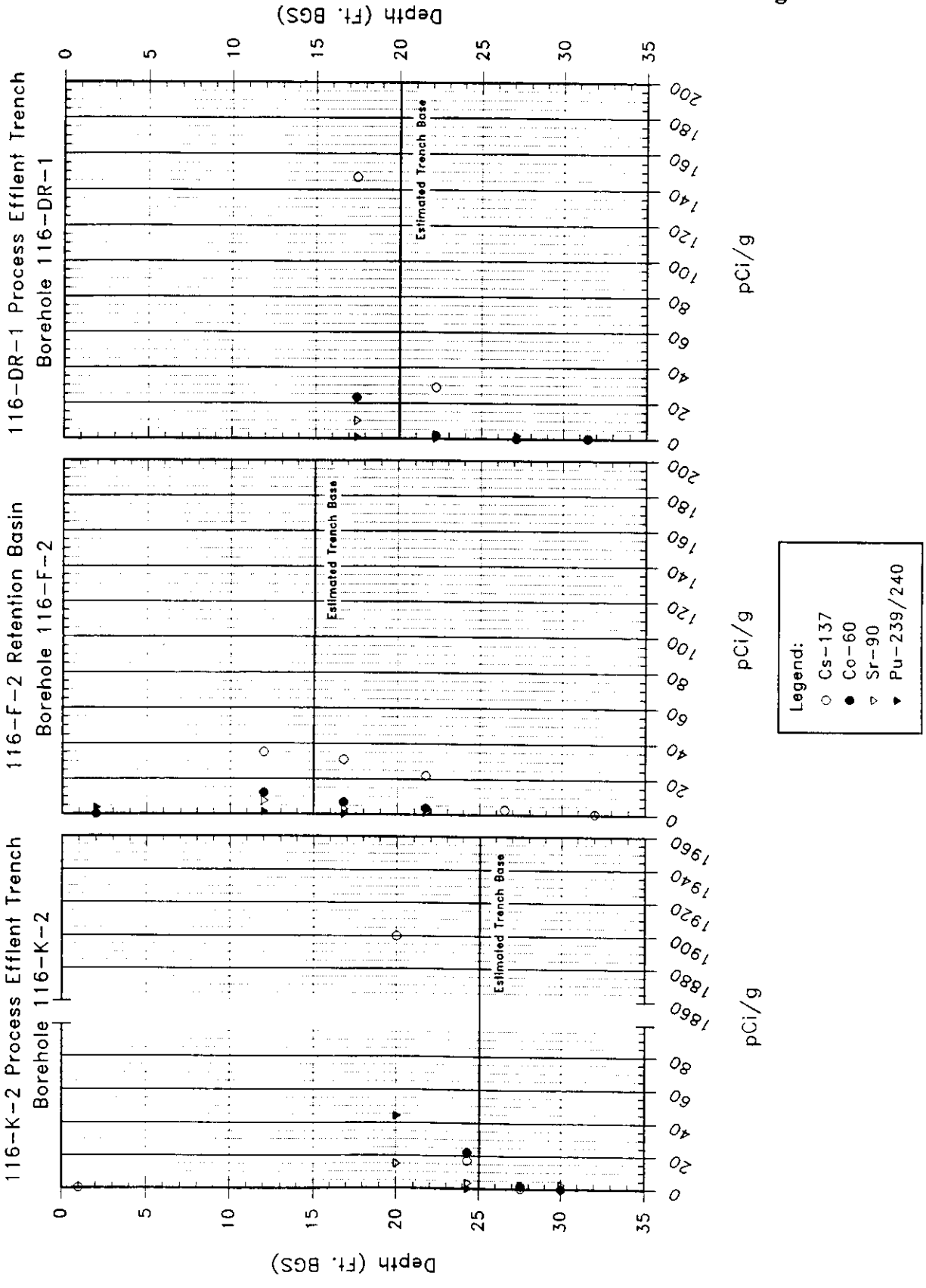


Figure 3-8. Radionuclide Distribution in the Vadose Zone at Analogous Sites.



4.0 STEP 1: PROBLEM STATEMENTS

4.1 Members of DQO Team and Decision Makers

The following is a listing of the DQO team members. Meeting minutes on file provide details of those present at each meeting. Technical Support and RL met from May 10 until June 21, 1995. EPA, Ecology, and RL met on June 21 and August 22, 1995. The regulators had provided written input to the DQO process before May 10, 1995 and indicated their desire to be involved after data compilation and conceptual model development. The following is a list of the DQO process participants.

Decision Makers

Phil Staats - Ecology
Pam Innis - EPA
Paul Pak - RL
David Olson - RL

Technical Support

Chuck Cline - Ecology
Merl Lauterbach - ERC 100-N Task Lead
Ed Shorey - ERC 100-N Assessment Lead
Mike Connelly - ERC Geoscientist
Kira Sykes - ERC 100-N LFI Team Lead
Steve Trent - ERC 100-N LFI Technical Lead
Scot Adams - ERC/DQO Facilitator In-Training
Bill Avolio - ERC Geoscientist/Field and Laboratory Analytical Support
Steven Clark - ERC Environmental Scientist
Randy Havenor - ERC 100-N Field Superintendent
Greg Mitchum - ERC Regulatory Support
Roger Ovink - ERC Risk Assessment Support
Craig Perkins - WHC 100-N Area Environmental Monitoring
Al Robinson - NISI Analytical and Field Screening/Radiochemist
Bob Scheck - Dames & Moore, RL Technical Support
Jeff Serne - Pacific Northwest National Laboratory (PNNL) Soil Scientist
Clay Smith - ERC Analytical Services
Scott Somers - NISI Field Measurements
Darci Teel - ERC Regulatory Support
Wendy Thompson - ERC Field Sampling Support
Steve Weil - ERC Sr. Technical Support

Facilitator

Mitzi Miller-DQO Facilitator provided by MACTEC

4.2 Description of the Problem

4.2.1 Current Conditions

The current MCLs in drinking water are 8 pCi/L for strontium-90. A pump-and-treat system to remove strontium-90 from the groundwater in the area between the 1301-N and 1325-N LWDFs and the river is underway as part of an ERA. Groundwater wells near the river indicate strontium-90 concentrations that range from nondetects below the MCL to ~4,000 pCi/L in 1994 per the DQO results documented in the *N-Springs Expedited Response Action Performance Monitoring Plan*. Strontium-90 results are predominantly below the MCL.

Surface radioactivity monitoring of the 1301-N and 1325-N LWDFs indicates significant exposure levels that would exceed any risk levels allowed by EPA. No characterization of the vadose zone directly under the cribs and trenches has been done, except the top 6 inches of sediments. Strontium-90 results from soil borings from wells between the 1301-N LWDF and the river indicate nondetects to 50 pCi/g. All parties agree that concentrations of strontium-90 and other radionuclides directly under and adjacent to the cribs and trenches are probably much higher than the concentrations downgradient away from the facilities.

Based on data collected in the vicinity of the LWDFs, the previous operational water table was much higher than today's water table. Concentrations of the nuclides in borings near the LWDFs appear to be higher in the vadose zone between the previous operational water table and the current water table. Based on the data from boreholes along the river and analyte mobility studies performed in Hanford Site soils, strontium-90 is more mobile than the other nuclides. Cobalt-60 is slightly less mobile and cesium-137 and plutonium-239/240 are the least mobile. No cesium-137 or plutonium-239/240 was observed in the borings along the river.

Decision makers agreed that nuclides, strontium-90, cesium-137, cobalt-60, and plutonium-239/240, were the primary COPCs, and dangerous waste metals (lead, cadmium, chromium, and nickel) were secondary contaminants for this LFI.

4.2.2 Conceptual Model

The conceptual model is discussed and summarized in Section 3.3 and Figures 3-1, 3-2, and 3-3 of this document.

4.2.3 Available Resources and Schedules

The schedule required that sampling be conducted on September 1, 1995. The planning process was completed before the beginning of sampling. The focus of RL was a reduction in the cost and personnel radiological exposure. The sampling and analysis plan generated after the initial SAFER workshop was more expensive and required more exposure than RL would permit. Section 10.0 of this document describes the alternatives for sampling and analysis, and

Section 11.0 compares the cost of the alternatives. The result of planning was a more cost effective sampling design and decreased worker radiation exposure.

4.2.4 Problems

All decisions will feed into the following problems:

1. The immediate and long-term problem is whether high concentrations of nuclides under the cribs and trenches are likely to migrate downward to groundwater and out to the river, increasing concentrations of strontium-90 or other nuclides of concern.

2. The radionuclide concentration at the surface of the cribs and trenches is high and would pose risk to humans. The-long term problem is whether the contaminants will migrate to groundwater, and ultimately the river, causing unacceptable risk. An additional problem is what remedial actions will be required to minimize risk and exposure.

This planning process focused on Problem 1. Problem 2 will be dealt with later in the 1301-N/1325-N Closure Plan/Corrective Measures Study. The data generated to address Problem 1 will be used to solve Problem 2 along with risk assessment and remedial alternative evaluation.

5.0 STEP 2: DECISIONS

5.1 Decisions

The planning process associates the problems with decisions and potential actions resulting from the decisions. Table 5-1 outlines the problems, decisions, and probable actions. The decision makers were unwilling to commit to direct actions from the decisions. No decision maker would consider not performing characterization. This was because of previous commitments made by all organizations to characterize the LWDFs.

Table 5-1. Problems, Decisions, and Probable Actions

Problems	Decisions	Potential Actions Resulting from Decisions
1) The immediate problem is whether high concentrations of radionuclides under the LWDFs are likely to migrate downward to groundwater and out to the river increasing concentrations of strontium-90 or other contaminants of concern.	Determine if immediate action is required to protect groundwater. This decision will be based on data pertaining to the current contaminant inventory in the vadose zone under the cribs and trenches, vadose zone moisture content, current depth to groundwater, contaminant soil partition coefficients, and other parameters that will permit the assessment of migration potential.	1) Assess the affect on selection of alternative(s) for final remedy of Strontium-90 contamination in groundwater. 2) Begin an evaluation of a multi-step approach to remediation of the LWDFs. 3) Determine the timing of the final remedial action for the LWDFs.
2) The radionuclide concentration at the surface of the LWDFs is high and currently poses a human health risk. The long-term problem is whether the high concentrations of contaminants will migrate to groundwater and ultimately migrate to the Columbia River increasing risk. A second problem is what actions will be required to minimize risk.	Long-term decisions include: 1) Determine if soil remediation is required and when remediation should be performed (if required). 2) Determine applicable remedial alternatives, the timing of remediation, and the volume and concentration of the material under the cribs and trenches requiring treatment or removal. 3) Determine the waste disposal strategy if either remove/dispose or remove/treat/dispose is selected as a remedial alternative.	Determine the waste disposal strategy should removal/disposal or removal/treatment/disposal be chosen as the remedial alternative. All parties agreed that removal of contaminated soil is a potential remedial alternative. The top layers of rock and soil from Zone 1 (see the conceptual models in Section 3.0) are the most likely targets for removal. The timing of any removal action will be determined in the evaluation of the remedial alternatives presented in the CMS using the data collected for the LFI.

5.2 Assumptions

The following assumptions are used to bound the scope of the DQO effort.

- The revised LFI workscope would result in reduced cost and worker radiation exposure.

- The RCRA closure certification decisions will not be based solely on this characterization effort.

  Full RCRA closure normally requires extensive sampling. The radioactive contaminants are of greater concentration and are driving remediation priorities. Given the radioactivity, the most logical approach may be to allow decay to occur for several years before performing a formal closure. This approach only is feasible if contaminants are not increasing in mobility and if institutional controls remain in place to prevent direct human exposure to soils. Because of high-level radioactivity in the samples, sample volumes available for dangerous waste analysis may be minimal. Therefore, dangerous waste characterization will be done as a lower priority than radionuclide characterization and vadose zone soil moisture content analysis. Vadose zone soil moisture analysis is considered high priority because downward movement of the soil moisture may provide a driving force for contaminant migration to groundwater.

- No remedial technology is presupposed.

- Selected samples, as specified in the DOW, will be archived by depth interval and boring location.

- The preliminary list of COPCs is based on process and historical information.

- The workscope identified as a result of the DQO workshop considers only the vadose zone contamination of 1301/1325-N LWDFs in the 100-NR-1 Operable Unit.

- The workscope is developed assuming funding is available to complete the work.

- The workscope will not change without appropriate review of the schedule and cost.

- The workscope is developed assuming the soil column could be safely accessed and doses are acceptable within ALARA limits.

A list of supplementary decisions were generated by Ecology and EPA. On examination, these decisions were identified as additional input to the decisions listed in Table 5-1.

6.0 STEP 3: INPUT

Each decision was listed and related to specific data input in Table 6-1. Data input were listed and compared to specific pieces and types of data needed to make the decisions in Tables 6-2 and 6-3. A "Y" indicates data are available. An "N" indicates data are not available. A "?" indicates the team was unsure whether the data were available.

To assess priority based on risk, remedial alternatives, and remediation timing, the concentration of contaminants, mobility of the contaminants to groundwater and the river, and the decay factors for radionuclides must be understood. The missing information is the concentrations of material in Zones 2, 3a, and 3b for all COPCs and the vadose zone soil moisture content. Effluent discharges to the 1301-N and 1325-N LWDFs were terminated in 1985 and 1990, respectively. However, residual soil moisture in the vadose zone beneath each facility could act as a driver for contaminant migration. The primary input information collected will be used to assess the presence of a driving force capable of inducing contaminant migration to the groundwater. This information will affect the ultimate timing of remediation, concentrations reaching the river, and volume of waste to be assessed for possible removal and treatment.

The COPCs were discussed; it was agreed that the following priority should be given as shown in Table 6-3.

Table 6-1. Input and Decisions from Ecology and EPA

Input	Decision
1. Determine inventory of strontium-90, cobalt-60, and cesium-137 left in the crib relative to that within the vadose zone; ultimately determine total amount released to the river.	1. High priority based on risk 2. Remedial alternatives
2. Determine the inventory of strontium-90 available to groundwater, including that within capillary fringe and associated with river fluctuations.	1. High priority based on risk 2. Remedial alternatives
3. Determine whether any transuranic waste is contained in the crib.	1. High priority based on risk 2. Remedial alternatives 3. Waste disposal strategy if remediated
4. Determine approximate radioactive waste volumes.	2. Remedial alternatives 3. Waste disposal strategy if remediated
5. Determine hazardous constituents and volumes.	1. High priority based on risk 2. Remedial alternatives 3. Waste disposal strategy if remediated
6. Determine risk associated with cleanup.	2. Remedial alternatives
7. Add valuable information for evaluation of costs associated with treatment and remediation.	2. Remedial alternatives 3. Waste disposal strategy if remediated
8. Evaluate/validate strontium-90 assumptions in model.	1. High priority based on risk 2. Remedial alternatives
9. Verify existence of erosional window (preferential pathways caused by erosional processes associated with Pleistocene cataclysmic flooding).	2. Remedial alternatives

Table 6-2. Data Input and Availability of Data Needed to Address Input (Page 1 of 2)

Input	Data Needed	Data Available (Y/N/NA/?)
1. Determine inventory of strontium-90, cobalt-60, and cesium-137 left in the LWDFs relative to that within the vadose zone; ultimately determine total amount released to the river.	Conc. of cobalt-60, cesium-137, and strontium-90 present in Zones 1, 2, 3a, 3b, 4a, 4b	Y-Zones 1, 4a, 4b N-Zones 2, 3a, 3b
	Geochem properties-pH, Eh, K_d	Y
	Soil lithology	Y
	Background	Y
	Flow rate	Y
	Transport time to river	Y
	Hydraulic conductivity Transmissivity Porosity Bulk density	Y-Zones 4a, 4b N-Zones 1, 2, 3a, 3b
	Volume material contaminated	Y-between 1301-N LWDF to River N-under crib/trench
	Percent moisture	Y-Zones 4a, 4b N-Zones 1, 2, 3a, 3b
	Inventory added	Y
2. Determine the inventory of strontium-90 available to groundwater, including that within capillary fringe and associated with river fluctuations.	See "data needed" for input #1.	See "data available for input #1.
3. Determine whether any TRU waste is contained in the crib.	Conc. TRU Zones 1, 2, 3a, 3b, 4a, 4b	Y-Pu Zone 1 Y-Zones 4a, 4b N-Zones 2, 3a, 3b
4. Determine approximate radioactive waste volumes.	Conc. strontium-90, cobalt-60, cesium-137 and TRU in Zones 1, 2, 3a, 3b, 4a, 4b	Y-Zones 1, 4a, 4b N-Zones 2, 3a, 3b
5. Determine hazardous constituents and volumes.	Inventory of hazardous waste	Y
	Conc. hazardous waste Zones 1, 2, 3a, 3b, 4a, 4b	Y-Zones 1, 4a, 4b N-Zones 2, 3a, 3b
	Geochem properties-pH, Eh, Kd	Y
	Soil lithology	Y

Table 6-2. Data Input and Availability of Data Needed to Address Input (Page 2 of 2)

Input	Data Needed	Data Available (Y/N/NA/?)
5. Determine hazardous constituents and volumes (continued).	Background	Y
	Flow rate	Y
	Transport time to river	Y
	Hydraulic conductivity Transmissivity Porosity Bulk Density	Y-Zones 4a, 4b N-Zones 1, 2, 3a, 3b
	Volume material contaminated	Y-between 1301-N LWDF to River N-under crib/trench
	Percent moisture	Y-Zones 4a, 4b N-Zones 1, 2, 3a, 3b
	Inventory added	Y
6. Determine risk associated with cleanup.	Conc. strontium-90, cobalt-60, cesium-137, and TRU in Zones 1, 2, 3a, 3b, 4a, 4b	Y-Zones 1, 4a, 4b N-Zones 2, 3a, 3b
	Remedial alternative	N
	Handling involved in remedial action	N
7. Add valuable information for evaluation of costs associated with treatment and remediation.	Cost to dispose TRU waste	??
	TRU waste disposal location	??
8. Evaluate/validate strontium-90 assumptions in model.	Information from input #1 allows validation of model	See input #1
9. Verify existence of erosional window	Log Hanford/Ringold contact	N

Table 6-3. Contaminants of Potential Concern and Soil Properties

COPC Type/ Soil Properties	Reason for Inclusion
1. Radionuclides: cobalt-60 cesium-137 strontium-90 plutonium-239/240	Key drivers to determine current risk in soil and groundwater, and driver to assess when material will decay enough to allow safe removal or remediation.
2. Soil moisture content	Soil moisture in the vadose zone may provide a driving force for contaminant migration to groundwater. Vadose zone soil moisture, physical properties of the vadose zone soils, capillary fringe contamination, and groundwater table fluctuations associated with Columbia River stage are parameters used in evaluating contaminant migration potential. If modeling or other similar evaluation techniques indicate a significant driving force may be present sufficient to cause movement of contaminants to groundwater at concentrations that exceed action levels, then the decisions of priority (#1) and time (#2) for remediation will be affected.
3. Metals	The past history of the RCRA Part A permit indicates primary contaminants to be lead, cadmium, mercury, and chromium from chromates.
4. Physical properties	Grain size distribution, soil moisture retention, hydraulic conductivity, and bulk density/porosity data will be used to assess contaminant migration and remedial alternatives.

It was agreed that mercury and organics (volatile and semivolatile) were not COPCs for this investigation. Sample handling requirements for these constituents combined with the current radiological conditions at the LWDFs would lead to significantly greater sampling and analysis costs and questionable sample quality, especially for the organic constituents. In addition, there is little evidence that significant organic contamination is present within or beneath the LWDFs. Historical sediment sampling and analysis in Zone 1 of the LWDFs indicated the presence of phthalates, which are common plastizers. However, these samples were collected in plastic jars, which likely contaminated the samples with the pthalates. In addition, one sample of 11 indicated a response for pyrene and chrysene above detection limits.

Sample quality and handling issues compelled the DQO work group to recommend that mercury and organics not be examined as part of the LFI. Collection of soil samples for mercury and organic analysis can be deferred to a future point in time because more data likely will be needed for final closure of the LWDFs. The available organic sediment and soil boring data are located in Appendix A1-1.

7.0 STEP 4: BOUNDARIES

Zones 1, 2, and 3a from the conceptual model define the vertical boundaries of the LFI. Decisions for remediation will apply to contaminated soils found within the boundaries of Zones 1, 2, 3a, and 3b of the conceptual model (see Section 3.0). The impacts of contamination on aquifer soils found in Zones 4a and 4b will be assessed based on existing well and boring data.

The lateral extent of soil contamination in the upper portion of the vadose zone is poorly defined outside the footprint of the LWDFs. Lateral extent of contamination was identified as a data need and will be addressed in the sampling design.

8.0 STEP 5: DECISION LOGIC

The DQO working group agreed that given the strontium-90 levels likely to be present in Zones 1 and 2, a qualitative risk assessment would confirm only that the site is a high health risk. Therefore, the next decision is whether the cleanup activity is a high priority because of contaminant migration to groundwater or because contaminant concentrations are significantly greater than currently hypothesized. With this information, a decision can be made as to which remedial alternative is reasonable and when the alternative should be implemented.

8.1 Hypothesis

The current hypothesis is that concentrations in Zones 2, 3a, and 3b will range between those of Zones 1 and 4. Table 3-1 provides the forecasted contaminant concentrations for each identified zone in the conceptual model. The current hypothesis is that the migration of contaminants to groundwater is minimal or absent due to the lack of a significant driving force. In this case, driving force is considered to be soil moisture, which may be draining to the aquifer from the vadose zone beneath the LWDFs.

8.2 Decision Rules

1. If the vadose zone soil moisture content, contaminant concentration profiles, and soil physical properties from the 1301-N LWDF are in general agreement with those expected from the conceptual model, no further LFI boreholes are needed.

2. If the vadose zone soil moisture content, contaminant concentration profiles, and soil physical properties from the 1301-N LWDF exceed or deviate significantly from the conceptual model, an additional evaluation will be performed to assess priority of performing further analysis.

   The vadose zone soil moisture and physical properties data will be used in combination with other environmental data to assess the migration of contaminants from the vadose zone to groundwater. The other environmental data include, but are not limited to, contaminant concentration depth profiles, trends in groundwater contaminant chemistry, current capillary fringe depth, groundwater levels, and river fluctuations.

3. The data gathered from the characterization borings located at the 1301-N LWDF combined with historical process data and geophysical logging (high-resolution spectral gamma-ray and neutron moisture logging) of existing wells located in the vicinity of the 1325-N LWDF can be used to create an analogous model for the 1325-N LWDF. If the data collected from characterization of the 1301-N LWDF and the geophysical logging data from the existing wells located near the 1325-N LWDF support the conceptual model, the analogous unit approach is valid for the 1325-N LWDF.

9.0 STEP 6: DECISION UNCERTAINTY

Preliminary calculations indicated an 80 to 90 percent certainty; the number of borings or sampling points would need to be in the 30-to-50 sample range. Collecting and analyzing this number of samples is not feasible because of worker exposure in the highly radioactive area. The original DOW required three borings. Little benefit will be gained in decision certainty by using one boring or three.

10.0 SAMPLING AND ANALYSIS ALTERNATIVES

The workscope of the original DOW, which was believed to be too costly and allowed too much worker radiation exposure, is compared to three alternatives. The three alternatives were developed using the following data quality objectives and associated criteria:

- Provide sufficient information to evaluate remedial alternatives
- Provide sufficient information to prepare a qualitative risk assessment
- Provide sufficient information to assess impact to groundwater and existence of a driving force
- Provide sufficient information to estimate total inventory and confirm conceptual model
- Provide sufficient information to assess lateral distribution
- Provide sufficient information to evaluate dangerous waste
- Provide sufficient information to evaluate transuranic waste
- Keep exposures as low as reasonably achievable (ALARA)
- Be cost effective.

10.1 Existing Description of Work

Three vadose zone borings would be constructed directly through the 1301-N and 1325-N LWDFs. Borehole locations are shown in Figure 10-1. The 1301-N crib borehole is located to intercept the expected maximum contaminant inventory in the 1301-N crib, whereas the 1301-N trench borehole is expected to encounter a smaller contaminant inventory. The 1325-N borehole is located in the crib structure to intercept the maximum contaminant inventory in the 1325-N crib. Only one borehole was sighted at the 1325-N LWDF because only the crib and the first 228 m (748 ft) of the trench received effluent. In addition, the 1325-N LWDF operated for a shorter time than the 1301-N LWDF.

Radiation at the two facilities is too high to allow drilling without reducing these levels by adding fill to act as a shield. The concrete panels would need to be removed as neither has sufficient integrity to support the drill rig or the required shielding. Boreholes would be drilled to penetrate no more than 1.5 m (5 ft) into the saturated zone and would have a depth of 19.8 to 22.8 m (65 to 75 ft).

The sampling strategy for the current DOW is listed in Table 10-1. The list of contaminants

includes volatile field screening. If field screening produced concentrations greater than 5 ppm above background, semivolatiles and pesticide/polychlorinated biphenyls would be performed. Further discussion in this DQO process could not resolve how volatiles would indicate presence of semivolatiles, pesticides, and polychlorinated biphenyls. Other alternatives do not contain the volatile field screening strategy.

10.2 Alternative 1

Alternative 1 is a modification of the existing DOW. Similar to the existing DOW, this alternative requires that three boreholes be placed directly through the LWDFs. In addition, geophyiscal logging of three existing boreholes is required. Figure 10-2 illustrates the drilling locations and summarizes the alternative. Alternative 1 also uses a reduced sampling and analysis strategy, as described in Table 10-1.

10.3 Alternative 2

Two vadose zone borings would be constructed to investigate the distribution of radionuclides, metal contamination, and vadose zone soil moisture content beneath the 1301-N crib and adjacent to the 1301-N trench. The locations of these borings are shown in Figure 10-3. The boring located in the 1301-N crib would provide data on the vertical distribution of contaminants with depth in the highest contaminant zone to verify the conceptual model. Vadose zone soil moisture content data also would be collected to evaluate the presence of a driving force for contaminant migration to groundwater. The borehole located adjacent to the 1301-N crib would provide information on the lateral spreading of contaminants, contaminant concentration with depth, physical properties of vadose zone soils, and vadose zone soil moisture content to verify the conceptual model and support the evaluation of contaminant migration potential. The analogous unit approach would be used to evaluate the 1325-N LWDF. The analogous unit approach would be supported by the addition of geophysical logging data from existing wells and boreholes near the 1325-N LWDF.

10.4 Alternative 3

Alternative 3 requires three boreholes: one borehole through the 1301-N crib; one adjacent to the 1301-N trench; and one downgradient and next to the 1325-N crib, as shown in Figure 10-4. The borehole logic for the 1301-N is the same as Alternative 2. The additional borehole at 1325-N would confirm the analogous approach. The sampling and analysis COPCs and strategy are the same as for Alternatives 1 and 2, as presented in Table 10-1.

10.5 Comparison of Alternatives

The DQO team compared the existing DOW and the alternatives to identify the best characterization approach for the 1301-N/1325-N LWDF LFI relative to the decision input and technical criteria discussed in Section 4.0. Results of the comparison are presented in Table 10-2. The comparison was performed by assigning a letter grade to the existing DOW and characterization alternatives for most of the decision input and technical criteria. The letter grades range from "A" (best) to "D" (worst) and provide a relative ranking for the existing DOW and each alternative with respect to the applicable decision input or technical criteria. No letter grades were provided for "remedial alternatives assessment" or "qualitative risk assessment" because both the existing DOW and alternatives provide sufficient data for these decision input. In addition, a numerical value is provided for the "exposure" criteria because it can be estimated easily based on the scope of work for the existing DOW and alternatives. Combining the grading system with the exposure estimates results in assigning a numerical rank ranging from "1" (best) through "4" (worst) to the existing DOW and alternatives.

Based on this comparison, Alternative 2 is identified as the preferred characterization approach. Alternative 2 provides data and information needed to sufficiently assess the lateral distribution of contaminants and potential impacts to groundwater at lower exposure and cost compared to the other alternatives and existing DOW. The DQO team recognized that the existing DOW and Alternative 1 provide more data and information than Alternative 2 relative to total inventory, dangerous waste, and transuranic primarily because more samples are collected. However, it was determined that the larger number of samples collected by the existing DOW and Alternative 1 still would not be sufficient to provide increased confidence on total inventory estimates, dangerous waste classification, or transuranic classification. In addition, the existing DOW and Alternative 1 result in much higher cost and exposure, while providing inferior information regarding lateral spreading of contaminants and potential impacts to groundwater, as compared to Alternative 2.

Alternative 3 compares favorably with Alternative 2 in all areas except cost. The increased cost of Alternative 3 is due to drilling and sampling of a third borehole next to the 1325-N crib. Alternative 2 is preferred over Alternative 3 because of the relative lower cost of Alternative 2.

10.6 Analyte List Comparison

A comparison of the COPCs and other environmental measurements included in the original DOW and the alternatives is presented in Table 10-1. The same analyte list is proposed for all alternatives except the original DOW. Contaminants were excluded from the COPC analyte list if process knowledge indicated that they were: 1) not present in the waste effluent disposed of to the LWDFs; 2) not observed in the existing groundwater and sediment database; or 3) inconsistently detected in sampled groundwater or soil media. Mercury, volatiles, semivolatiles, pesticide/polychlorinated biphenyls, fluoride, nitrate/nitrite, and sulfate fall into these categories. Because soil washing is no longer a likely remedial alternative for highly

contaminated soils, total carbonate, total organic carbon, and cation exchange capacity were removed from the COPC list.

10.7 Sampling and Analysis Scheme

The Sampling and Analysis Plan for the DQO alternatives is described in Appendix E of the revised DOW (DOE/RL 1995). Four split-spoon samples and seven grab samples will be collected from each borehole. In addition, high-resolution spectral gamma-ray and neutron moisture logging will be performed before casing strings are telescoped. Analytes and other environmental measurements to be performed are listed in Table 10-3.

Figure 10-1. Current Description of Work

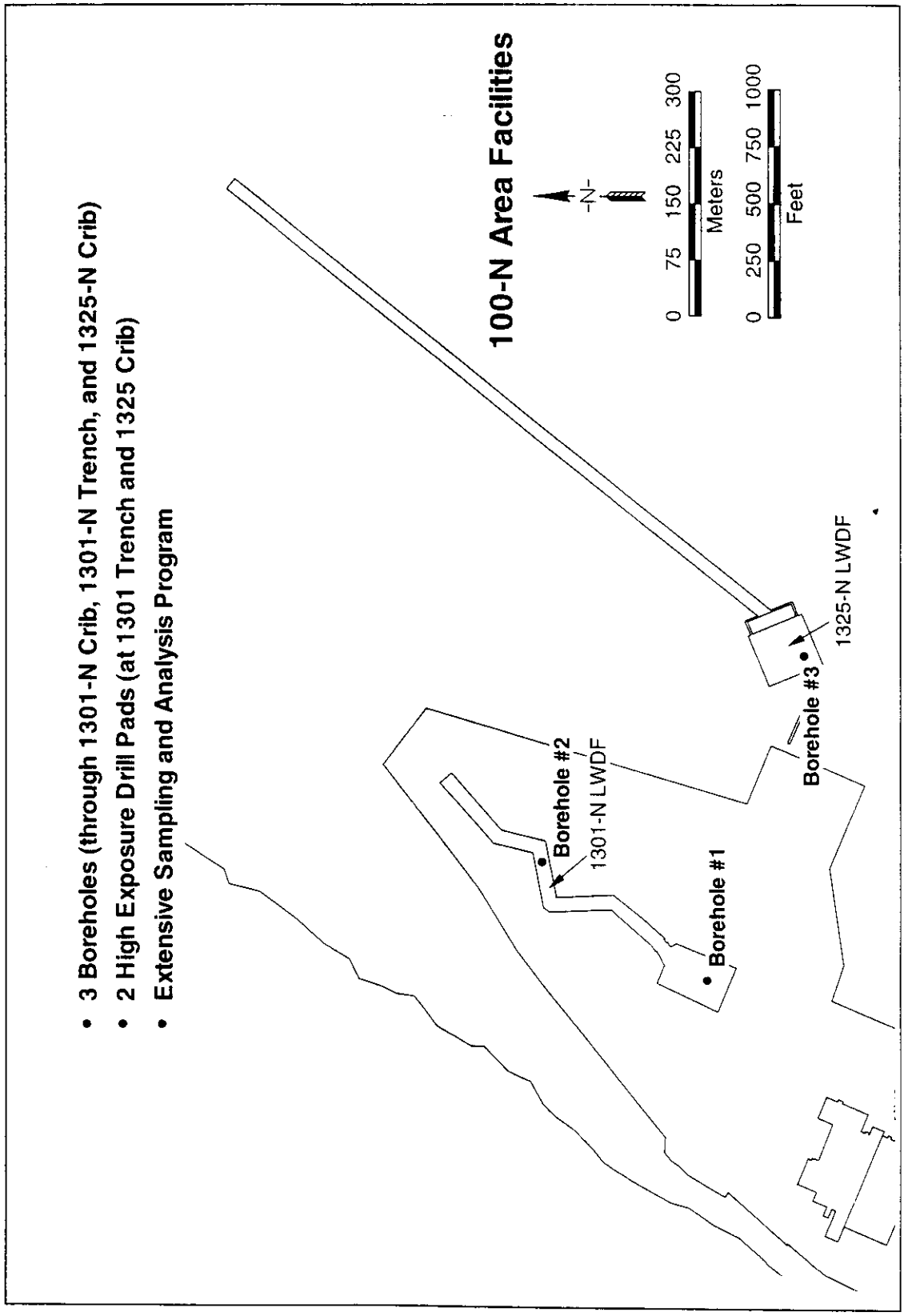


Figure 10-2. Alternative 1

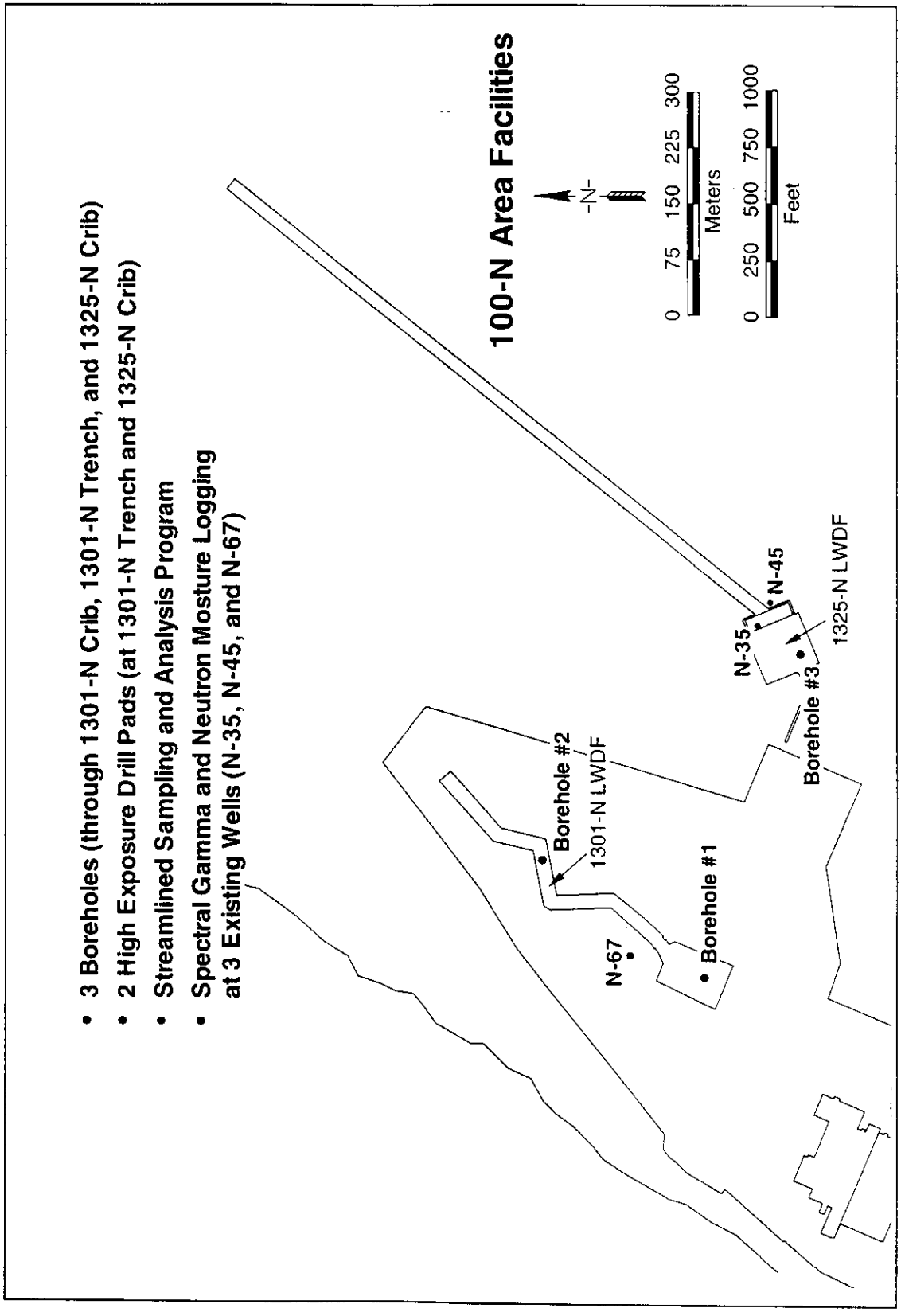


Figure 10-3. Alternative 2

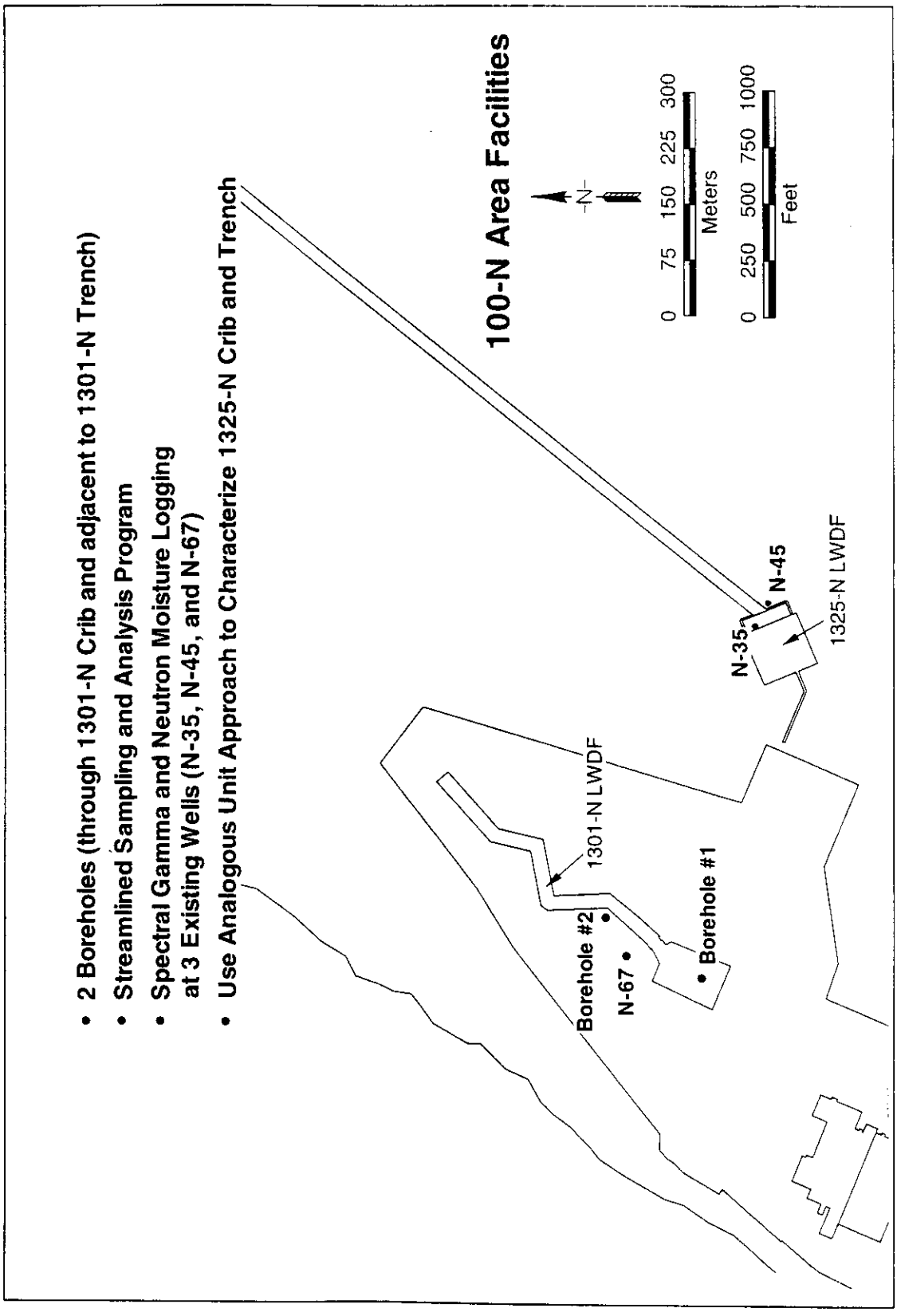


Figure 10-4. Alternative 3

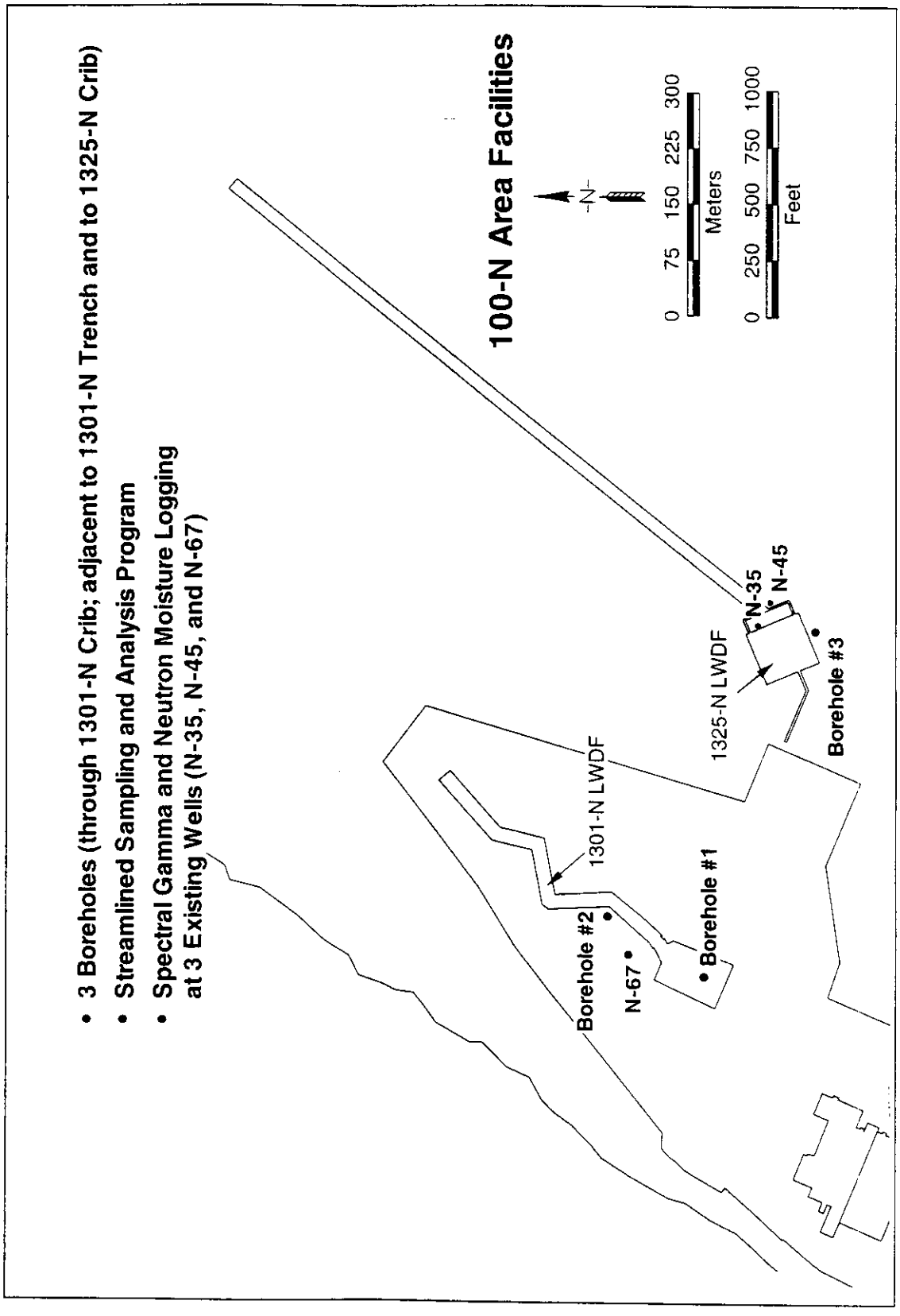


Table 10-1. Comparison of Current and Alternative DOW Sampling and Analysis Plan - Analyte List (Page 1 of 3)

Analyte/COPC	Method/Technique	Current DOW	Alternate DOW	Rationale/Comments
Gross Alpha Gross Beta	Gas Proportional Counter	✓	✓	COPC
Strontium-90	Radiochemical Separation and Beta Counting	✓	✓	COPC/additional vertical distribution data obtained by downhole strontium-90 measurement via Y-90 bremstrahlung gamma are being investigated.
Potassium-40 Manganese-54 Cobalt-60 Ruthenium-106 Cesium-134 Cesium-137 Cerium-144 Europium-154 Europium-155 Radium-226 Thorium-228 Thorium-232	Gamma Spectrometry (Laboratory and Downhole Logging)	✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓	✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓	COPC
Uranium-233/234 Uranium-238 Plutonium-238 Plutonium-239/240	Alpha Spectrometry	✓ ✓ ✓ ✓	✓ ✓ ✓ ✓	COPC/may be needed to evaluate TRU
Cadmium Chromium (VI) Lead Nickel	ICP	✓ ✓ ✓ ✓	✓ ✓ ✓ ✓	COPC
Mercury	Atomic Absorption	✓		The mercury analysis has short holding time compared to all of the other radiation and metal analyses to be proposed in the revised DOW. This creates a significant problem in the batching and shipping of the samples and will result in increased cost.
Volatile Organics	CLP-TCL, VOCs	✓		Not a COPC. Presumed to have largely volatilized if ever present, will not significantly affect remediation decisions. Analysis is costly and has a short holding time (days); thus, it also will increase cost due to batching and shipping considerations.

Table 10-1. Comparison of Current and Alternative DOW Sampling and Analysis Plan - Analyte List (Page 2 of 3)

Analyte/COPC	Method/Technique	Current DOW	Alternate DOW	Rationale/Comments
Semivolatile Organics, Pesticides, and PCBs	CLP-TCL, SVOCs, etc.	✓		Not a COPC. No evidence that compounds are present, and will not affect remediation decisions. Analysis is costly and has a short holding time (days); thus, it will also increase cost due to batching and shipping considerations.
Fluoride Nitrate/Nitrite Sulfate	EPA 300.0	✓ ✓ ✓		No added value. Anions are highly mobile, moved through soil column, no historical positive groundwater detects nearing MCL limits.
Total Carbonate	EPA 310.1	✓		Not useable for qualitative risk assessment (QRA), formation ion exchange potential expended, demineralized water as influent. Used for soil washing remedial design, which is no longer feasible for highly contaminated soils.
Total Organic Carbon	EPA 415.2	✓		Same as Total Carbonate.
Cation Exchange Capacity	EPA 9081A	✓		Same as Total Carbonate.
Grain Size Distribution and Contaminant Conc.	Combination	✓		Generally used for soil washing remedial design; no QRA value.
Grain Size Distribution	WHC/GEL or ASTM	✓	✓	May be needed to help interpret moisture logging data. There may be a radiological dose problem with 1 liter sample requirement. This sample would be optional, based on ALARA.
Bulk Density	WHC/GEL or ASTM	✓		Enough data currently available, assumed bulk density is 1.6 g/cm^3.

Table 10-1. Comparison of Current and Alternative DOW Sampling and Analysis Plan - Analyte List (Page 3 of 3)

Analyte/COPC	Method/Technique	Current DOW	Alternate DOW	Rationale/Comments
Moisture Content	Neutron Moisture Logging/Physical Sampling	✓	✓	Physical samples may be taken to assist in the interpretation of logging data. There may be a radiological dose problem with sample volume requirement. This sample would be optional, based on ALARA.
Total Activity	WHC/222S Liquid Scintillation	✓	✓	Required for samples that are shipped offsite to PNNL or to other Commercial

Table 10-2. 1301-N and 1325-N LWDF Characterization Data Quality Objectives, Technical Criteria

Alt	Type	Description	Impact to GW, Driving Force	Total Inventory Conceptual Model	Lateral Distribution	Dangerous Waste	TRU	Remedial Alt	QRA	Exposure (Person-rem)	Relative Cost	Rank
	Existing DOW Full SAP/QAPP	Borings at 1301 Crib, Trench and 1325 Crib. Full laboratory analysis.	C	B+	D	C+	C+	✓	✓	14	D	4
1	Streamlined DOW Streamlined SAP/QAPP RLS, Moisture (N-5, N-35 and N-45)	Boring at 1301 Crib 1301 Trench and 1325 Crib. Limited Sample handling.	B+	A	C	C+	C+	✓	✓	13	C	3
2	Streamlined SAP/QAPP 2 Boreholes RLS, Moisture (N-5, N-35 and N-45)	Boreholes at 1301 Crib and side of 1301 Trench.	A-	C+	A	C	C	✓	✓	2	A	1
3	Streamlined SAP/QAPP 3 Boreholes RLS, Moisture (N-5, N-35 and N-45)	Boring at 1301 Crib side borings at 1301 Trench and 1325 Crib or Trench.	A	C+	A	C	C	✓	✓	3	B	2

Note: The lettering system was used for ranking alternatives in the DQO Workshop.

Table 10-3. Analytical Methods, Analytical Parameters, Detection Limits, and Precision and Accuracy Requirements (Page 1 of 3)

	Analytical Category	Analytical Parameters	Analytical Method	Detection Limit	Container Type/Volume or Mass	Maximum Holding Time
Split-Spoon Samples	Metals	Cadmium Chromium Lead Nickel	SW-846; Method 6010 ICP - Metals	1.0 ppm	amber glass 40 mL	6 months
	Radionuclides	Strontium-90	Sr-02[a]	1.0 pCi/g	amber glass 60 mL	6 months
		Alpha Spectrometry Uranium-233/234 Uranium-238 Plutonium-238 Plutonium-239/240	ASTM D 3084[b]	0.6 pCi/g (for all parameters)		
		Gross alpha	Water 901.1 Soil[c]	7.0 pCi/g		
		Gross beta	Water 901.1 Soil[c]	8.0 pCi/g		
		Gamma Spectrometry Potassium-40 Manganese-54 Cobalt-60 Ruthenium-106 Cesium-134 Cesium-137 Cerium-134 Europium-154 Europium-155 Radium-226 Thorium-228 Thorium-232	Water 901.1 Soil[c]	 10.0 pCi/g 0.25 pCi/g 0.05 pCi/g 1.5 pCi/g 0.25 pCi/g 0.25 pCi/g 0.75 pCi/g 0.75 pCi/g 0.75 pCi/g 4.5 pCi/g 0.6 pCi/g 0.6 pCi/g		
	Offsite Shipping Requirements	For less than detectable rad samples: total activity only	222-S Laboratory Liquid Scintillation	50.0 pCi/g	20 mL	6 months
		For Radioactive Samples: Gross alpha Gross beta Gamma emitters Strontium-90	222-S Laboratory Methods	 1.0 pCi/g 4.0 pCi/g 0.05 pCi/g 1.0 pCi/g		

Table 10-3. Analytical Methods, Analytical Parameters, Detection Limits, and Precision and Accuracy Requirements (Page 2 of 3)

	Analytical Category	Analytical Parameters	Analytical Method	Detection Limit	Container Type/Volume or Mass	Maximum Holding Time
Split-Spoon Samples	Physical Properties	Moisture Content	ASTM D2216 (GEL-14)	N/A	moisture tin (sealed) 400 g	N/A
		Moisture Retention	ASTM D2325 ASTM D3152 (GEL-18)	N/A	one 6-in. capped split-spoon liner	N/A
		Bulk Density/Porosity	ASTM D2937 ASTM D4564 (GEL-14)	N/A		
		Permeability	ASTM D2434 (GEL-09)	N/A		
		Particle Size Distribution	ASTM D422 (GEL-07)	N/A	depends on grain size, one 6-in. capped split-spoon liner minimum	N/A
Geophysical Logging	Radionuclides	Strontium-90	Sr-02[a]	1.0 pCi/g	amber glass 40 mL	6 months
		Gross Alpha	Gas Proportional	7.0 pCi/g		
		Gross Beta	Gas Proportional	8.0 pCi/g		
		Gamma Spectrometry Potassium-40 Manganese-54 Cobalt-60 Ruthenium-106 Cesium-134 Cesium-137 Cerium-134 Europium-154 Europium-155 Radium-226 Thorium-228 Thorium-232	Gamma Spectrometry	0.05 pCi/g (for all parameters)		
	Physical Properties	Moisture Content	ASTM D2216	N/A	moisture tin	N/A
		Particle Size Distribution	ASTM D422 (GEL-07)	N/A	double-wrapped plastic bag; 1 kg minimum	N/A

Table 10-3. Analytical Methods, Analytical Parameters, Detection Limits, and Precision and Accuracy Requirements (Page 3 of 3)

	Analytical Category	Analytical Parameters	Analytical Method	Detection Limit	Container Type/Volume or Mass	Maximum Holding Time
Geophysical Logging	Radionuclides	Gamma Spectrometry	RLS		N/A	N/A
		Uranium-233		150.0 pCi/g		
		Uranium-234		300.0 pCi/g		
		Uranium-238		25.0 pCi/g		
		Plutonium-238		1.6 nCi/g		
		Plutonium-239		20.0 nCi/g		
		Plutonium-240		85.0 nCi/g		
		Gamma Spectrometry	RLS			
		Potassium-40		2.0 pCi/g		
		Manganese-54		1.0 pCi/g		
		Cobalt-60		1.0 pCi/g		
		Ruthenium-106		5.0 pCi/g		
		Cesium-134		1.0 pCi/g		
		Cesium-137		1.0 pCi/g		
		Cerium-134		5.0 pCi/g		
		Europium-154		1.0 pCi/g		
		Europium-155		10.0 pCi/g		
		Radium-226		5.0 pCi/g		
		Thorium-228		5.0 pCi/g		
		Thorium-232		1.0 pCi/g		
	Physical Properties	Moisture Content	Neutron Moisture Logging	2% VFW		

[a]Methods specified are from the *EML Procedures Manual* (Chieco et al. 1990)

[b]Method specified is from the *1993 Annual Book of ASTM Standards* (ASTM 1993).

[c]Method shall be based on the specified water method, modified to allow measurement of the parameter of interest in a soil sample, and shall be submitted for Bechtel Hanford, Inc. review and approval prior to use.

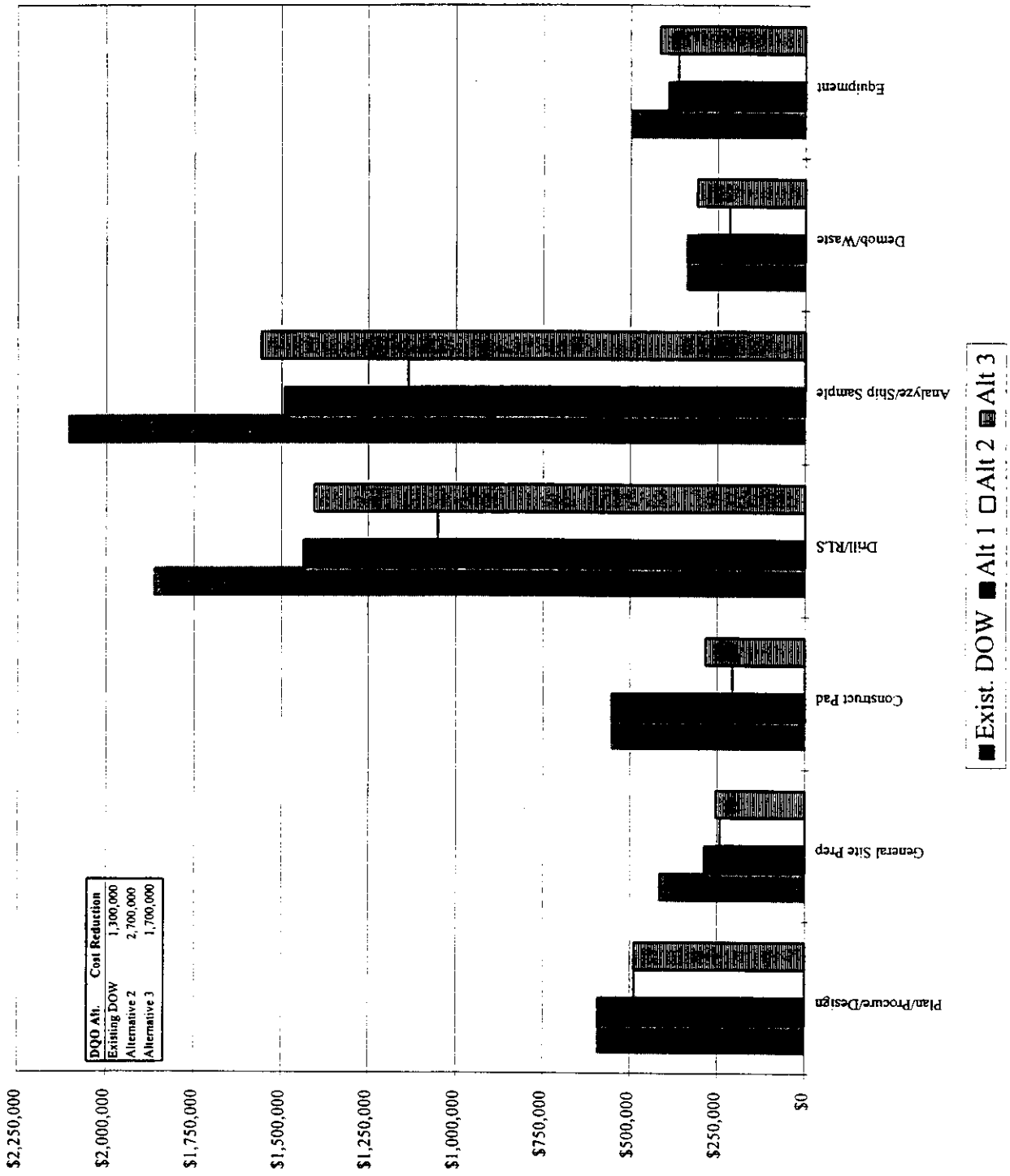
ASTM - American Society of Testing and Materials
GEL-## - Westinghouse Hanford Company Geotechnical Engineering Laboratory
N/A - Not Applicable
RLS - Radionuclide Logging System
VFW - Volume Fraction Water

11.0 COST COMPARISON

To evaluate the cost effectiveness of the DQO alternatives, estimates of cost reductions were prepared. These cost reductions were estimated by comparing cost components required in the existing DOW to those components required in the alternatives. For instance, the existing DOW required three drill pads to drill three boreholes. In Alternative 2, only two drill pads (for two boreholes) were required, which deleted the cost for the third pad. Another cost reduction example was to reduce equipment costs by a certain percentage if fewer samples were collected. The results of the cost reduction evaluation is presented in Figure 11-1.

Detailed cost estimates were not prepared because of time constraints. However, detailed engineering costs were not required to compare costs. All costs discussed do not include contingency. Alternative 3 approximate costs were $3.5 million while Alternative 2 approximate costs were $2.4 million. The original DOW cost was estimated at $5.52 million. Alternative 2 provided the most cost savings compared to the existing DOW.

Figure 11-1. DQO Alternative Cost Comparison.



12.0 EXPOSURE COMPARISON

Exposure comparisons were calculated in the same manner as the cost comparisons. If one borehole was deleted from the original scope, all exposures associated with activities at that borehole location were removed. The person-rem exposure was totaled for each alternative and is presented in Table 12-1. Alternatives 2 and 3 reduced the exposures significantly compared to the existing DOW.

Table 12-1. Radiation Exposure Summary

SUMMARY OF ESTIMATED RADIATION EXPOSURES		
Alternative	**Major Expsures[1] (person-rem)**	**Comments**
Existing DOW	Total = 14 person-rem site preparation = 1.5 1301 Crib 0.15; 1301 Trench 0.52; 1325 Crib 0.85 drill pad construction = 7 1301 Crib 0.3; 1301 Trench 2.1; 1325 Crib 4.7 drilling = 2.95 1301 Crib 0.95; 1301 Trench 0.68; 1325 Crib 1.3 sampling = 0.80 1301 Crib 0.25; 1301 Trench 0.20; 1325 Crib 0.35 demobilization = 1.0 1301 Crib 0.30; 1301 Trench 0.30; 1325 Crib 0.40 RLS = 0.2	High exposures occur during drill pad construction in the middle of 1301-N Trench and 1325-N Crib over concrete panels (labor intensive in a high radiation field). High exposures occur during sample handling (labor intensive with a hot source). High exposures during general site prep at 1324-N Crib because of radiation field. High exposures occur during waste handling (emptying core barrel/filling drums) because exposure rates could be as high as 5 R/hr. The exposures for long-term management of the waste once it is in long-term storage are negligible.
Alternative 1 3 boreholes streamlines SAP/QAPP RLS	Total = 13 person-rem site preparation = 1.5 drill pad construction = 7 drilling = 2.4 sampling = 0.40 demobilization = 1.0 RLS = 0.2	High exposures occur during drill pad construction in the middle of 1301-N Trench and 1325-N Crib over concrete panels (labor intensive in a high radiation field). Reduces exposures during sample handling; less samples collected; lower volume shipped. High exposures during general site prep at 1325-N Crib because of radiation field.
Alternative 2 1 crib, 1 side borehole streamlined SAP/QAPP RLS	Total = 2 person-rem site preparation = 0.35 drill pad construction = 0.30 drilling = 0.95 sampling = 0.15 demobilization = 0.35 RLS = 0.2	Reduces exposures during drill pad construction because pad will be placed adjacent to the 1301-N Trench (no more concrete panel problems) and other drill pad is eliminated. Reduces exposures during sample handling (less samples collected, lower volumes shipped than existing DOW). Eliminates exposures during general site prep, drilling and sampling at 1325-N Crib.
Alternative 3 1 crib, 2 side borehole streamlined SAP/QAPP RLS	Total = 3 person-rem site preparation = 0.45 drill pad construction = 0.30 drilling = 1.1 sampling = 0.25 demobilization = 0.4 RLS = 0.2	Reduces exposures during drill pad construction because pad will be placed adjacent to the 1301-N Trench and 1325-N Crib (no more concrete panel problem). Reduces exposures during sample handling (less samples collected, lower volumes shipped than existing DOW, but more than Alternative 2).

13.0 CONCLUSION AND RECOMMENDATIONS

The existing data for the 1301-N and 1325-N LWDFs indicate that significant quantities of cobalt-60, strontium-90, and cesium-137 were discharged to these facilities. Lesser amounts of plutonium also were discharged to the LWDFs.

High concentrations of all four radionuclides are present in the near-surface sediments of the cribs and trenches. Significantly less concentrations of cobalt-60, strontium-90, and cesium-137 occur outside the footprint of the cribs and trenches. Concentrations of strontium-90 decrease from the nCi/g level directly under 1301-N LWDF to 50 pCi/g in soil near the river at the 199-N-94A well. Concentrations of cesium-137 and cobalt-60 are in the μCi/g range directly beneath the 1301-N LWDF and likely decrease quite rapidly with depth.

Strontium-90 concentrations are in the pCi/g level outside the footprint of the LWDFs in the vadose zone soils once saturated with effluent originating from facilities. Most of the strontium-90 located outside the LWDF footprints now is stranded in the vadose zone.

This DQO summary presents the current status of the process. The RL and the ERC believe that Alternative 2 is the most cost effective while still providing the data necessary for the decisions. Ecology and EPA indicate that Alternative 3 is preferred. All parties agree that the original DOW and Alternative 1 are not the preferred strategies.

Alternatives 2 and 3 require one boring in the 1301-N crib to evaluate the observed contaminant distribution relative to the conceptual model. Both alternatives require one boring near the highest surface concentration area, but not directly in the 1301-N trench, to provide data in regard to lateral movement and physical characteristics at a low cost and exposure.

If Alternative 2 is used, 1325-N LWDF will be assumed to be an analogous site. This is thought to be a conservative assumption. The 1301-N LWDF should present higher concentrations than 1325-N LWDF for the following reasons.

- Discharges to the 1325-N LWDF were significantly less than discharges to the 1301-N LWDF. In addition, the 1325-N LWDF operated for a shorter time.
- The 1325-N trench was added to improve the flow of water because the associated crib did not achieve the desired infiltration capacity.
- The 1301-N LWDF saturated the subsurface soil and allowed strontium-90 to reach the Columbia River before construction of the 1325-N LWDF.

The high resolution spectral gamma-ray and neutron moisture logging in both characterization borings at the 1301-N LWDF and the three existing wells will provide sufficient data to confirm the analogous site theory without the cost of an additional boring near the 1325-N LWDF.

Geophysical logging data were thought to provide a good indicator as to whether the 1325-N LWDF is analogous to 1301-N LWDF. However, Ecology and EPA perceive that more information than the logging is required to validate the analogous site theory. In addition, the ability of the high-resolution spectral gamma-ray logging to provide adequate data for strontium-90 (a beta particle emitter) via the brehmstrahlung effect still is under development. The inability to adequately characterize the distribution of strontium-90 at the 1325-N LWDF could lead to incorrect assumptions for modeling and remedial cost estimates.

All parties eventually agreed to perform Alternative 3 due to concerns expressed by Ecology and EPA regarding the analogous unit approach at the 1325-N LWDF.

14.0 REFERENCES

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APPENDIX A-1

1301-N/1325-N LWDF
EXISTING DATA PACKAGE

SEDIMENT DATA
1301-N TRENCH AND 1325-N CRIB

Figure A1-1. Sediment Sampling Locations for the 1301-N and 1325-N LWDFs.

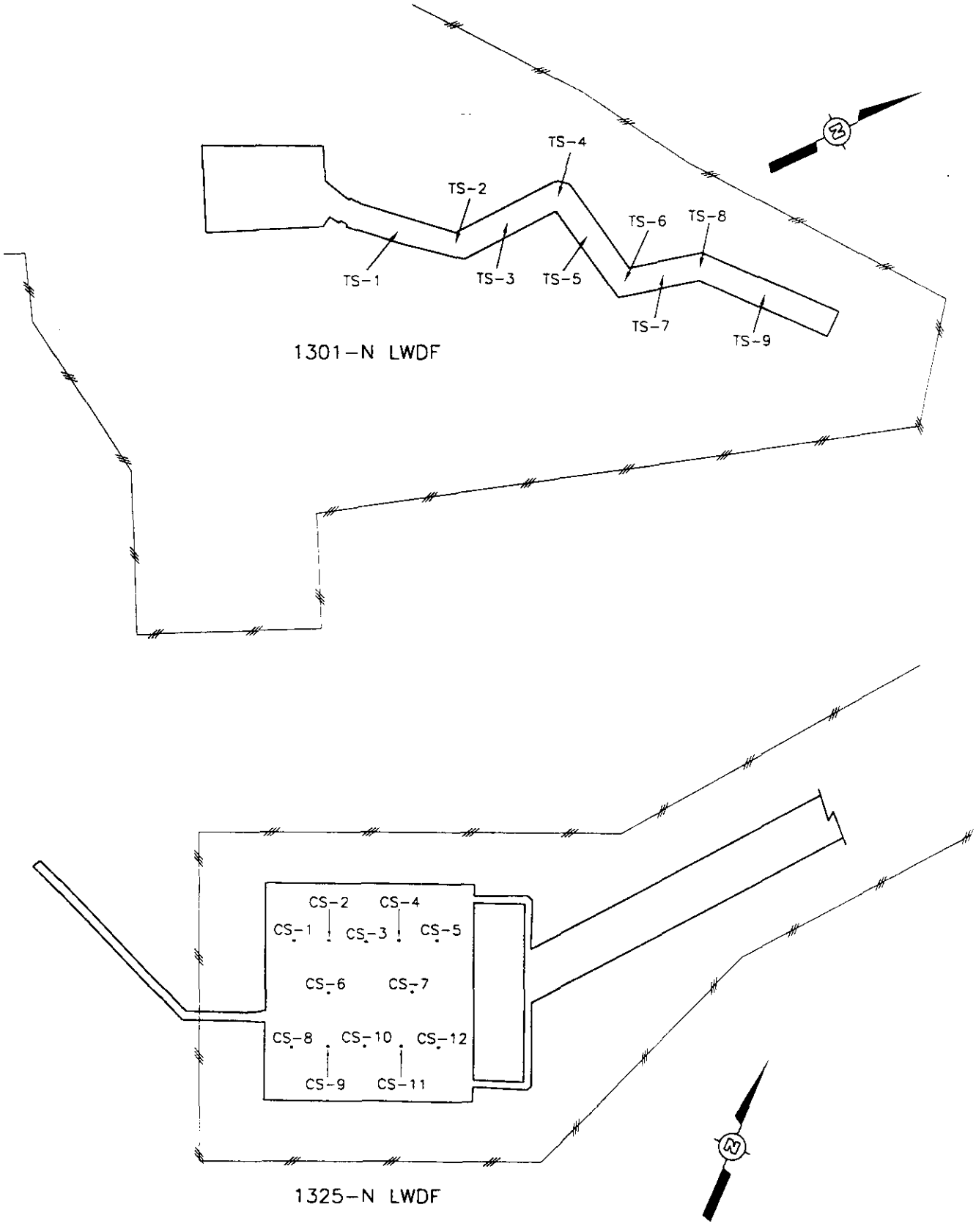
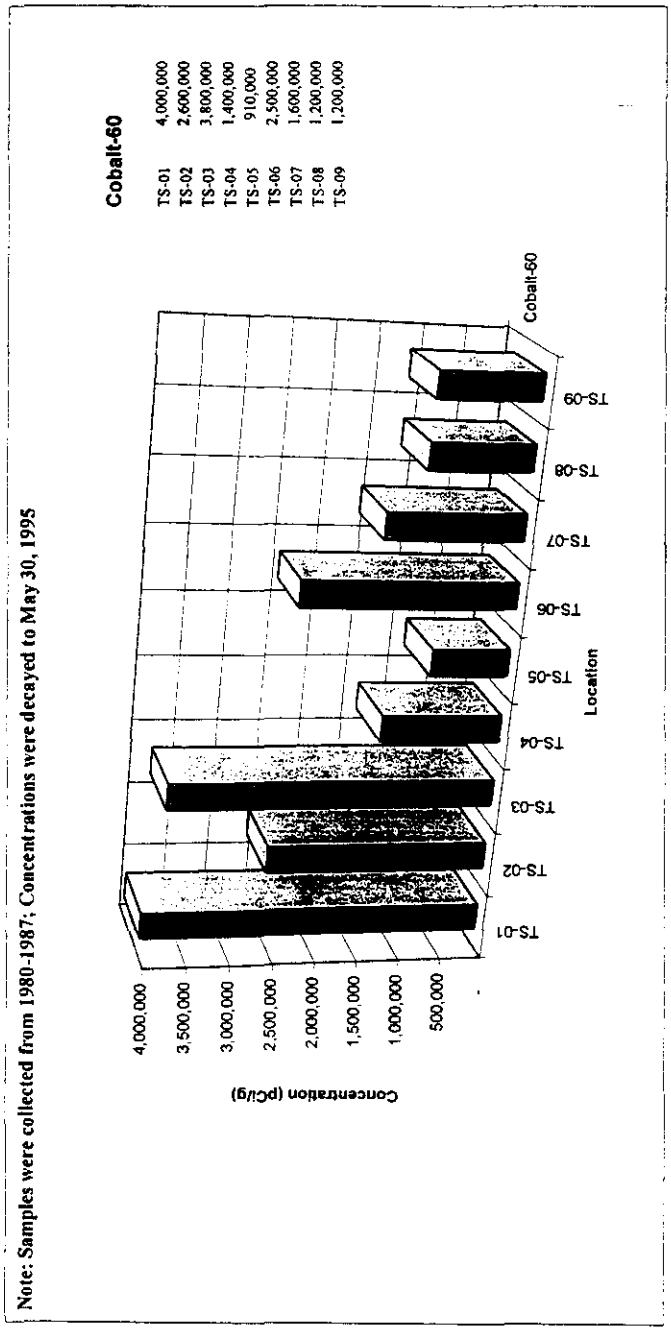


Figure A1-2. Average Concentrations in 1301-N Trench Decayed to May 30, 1995. (Page 1 of 2)



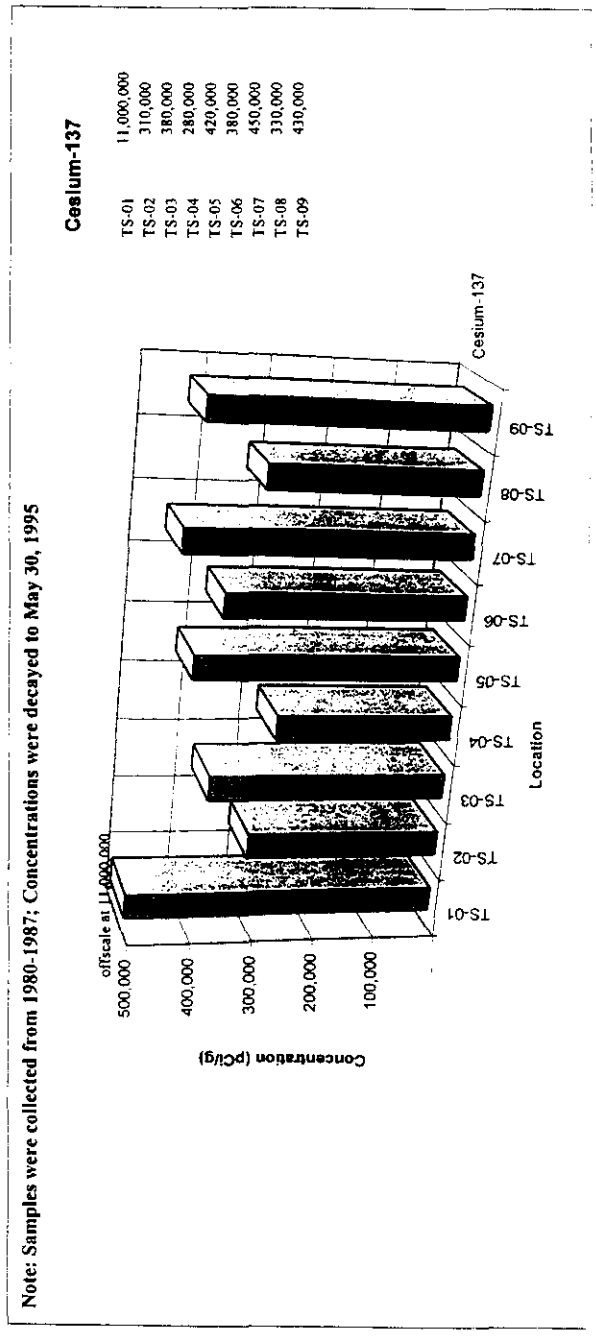
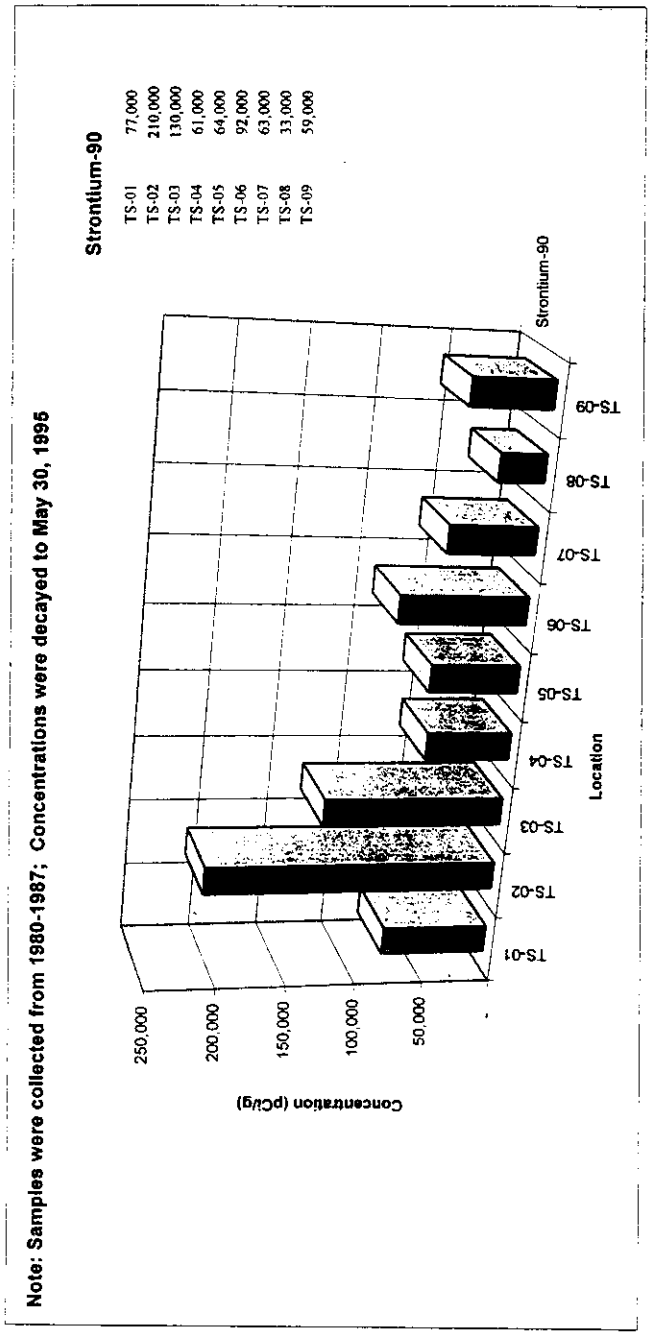


Figure A1-2. Average Concentrations in 1301-N Trench Decayed to May 30, 1995. (Page 2 of 2)



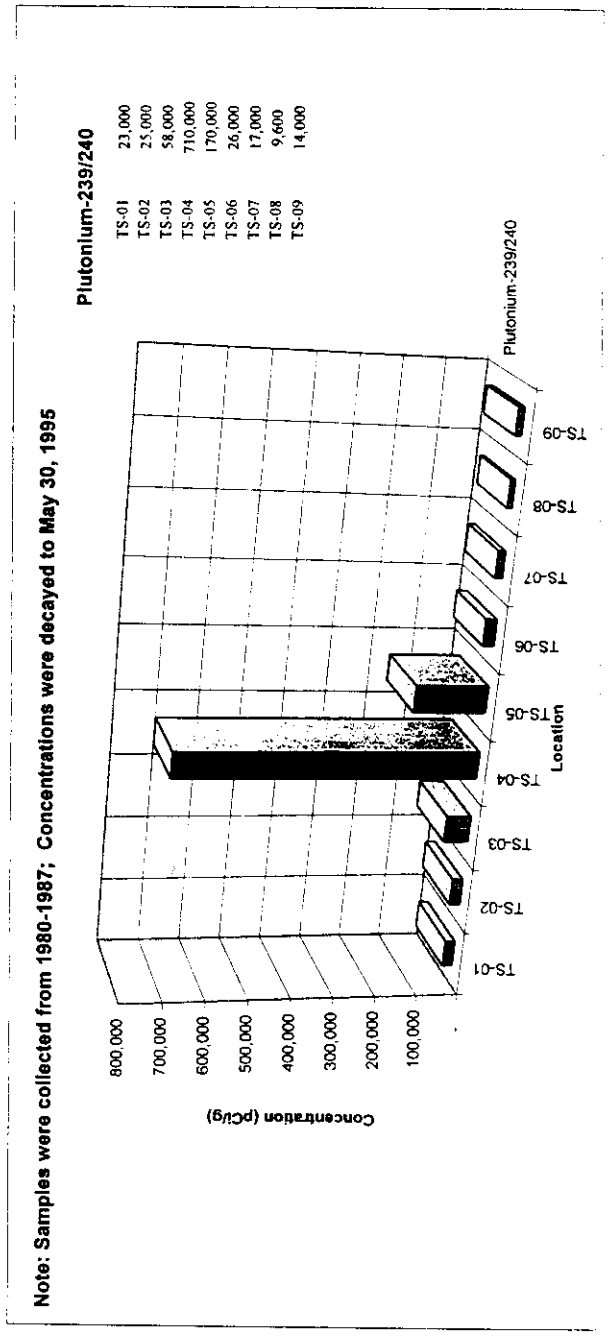
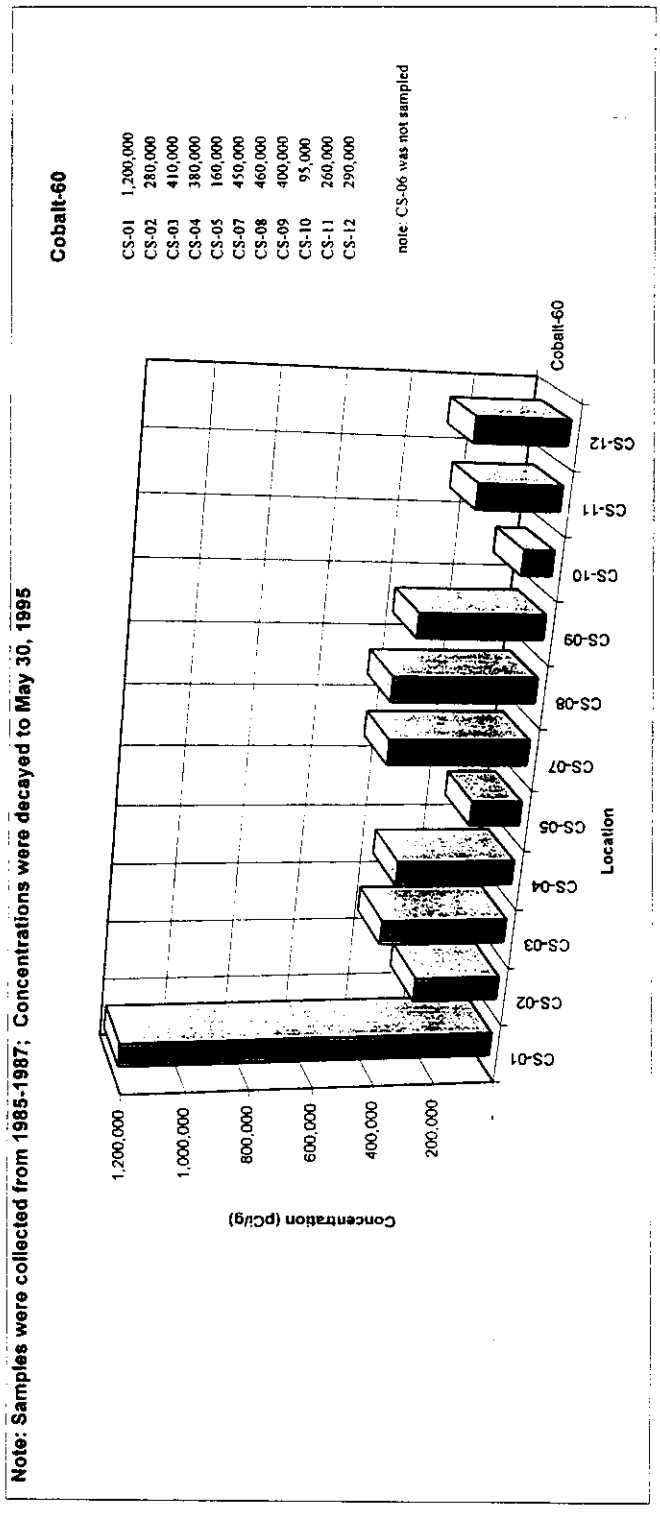


**Figure A1-3. Average Concentrations In 1325-N Crib Decayed to May 30, 1995.
(Page 1 of 2)**



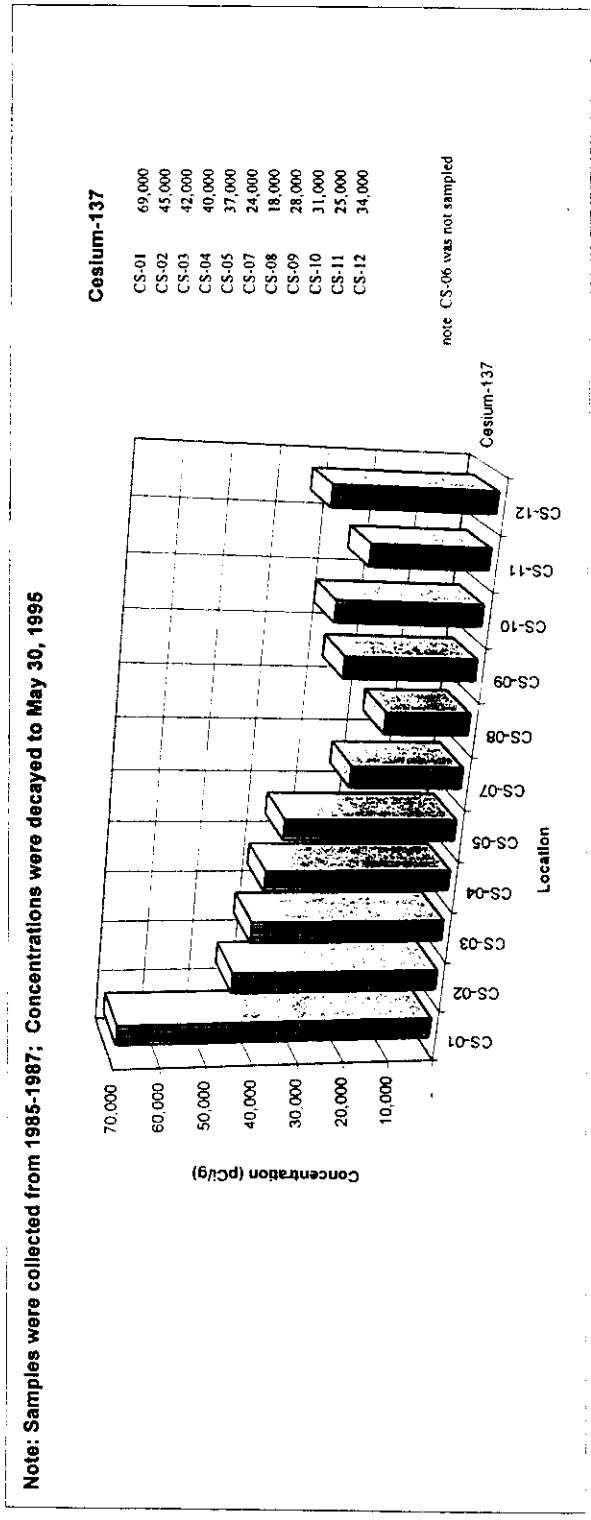
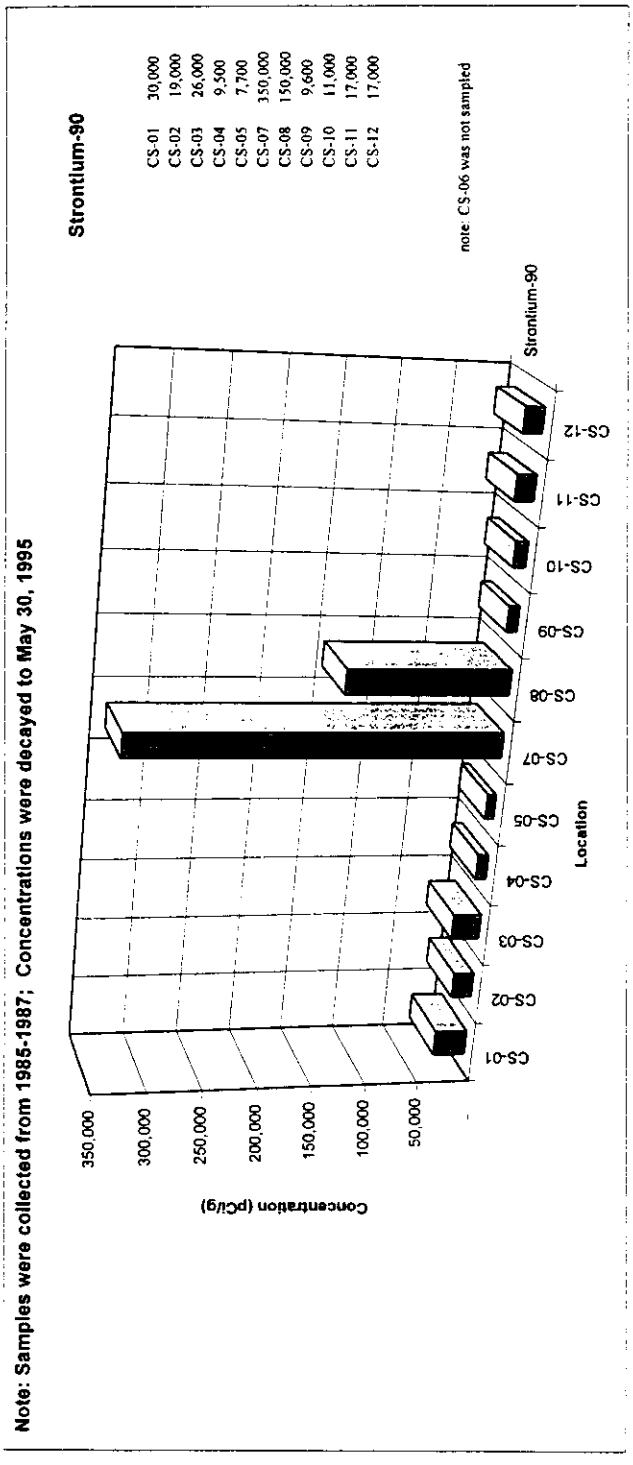
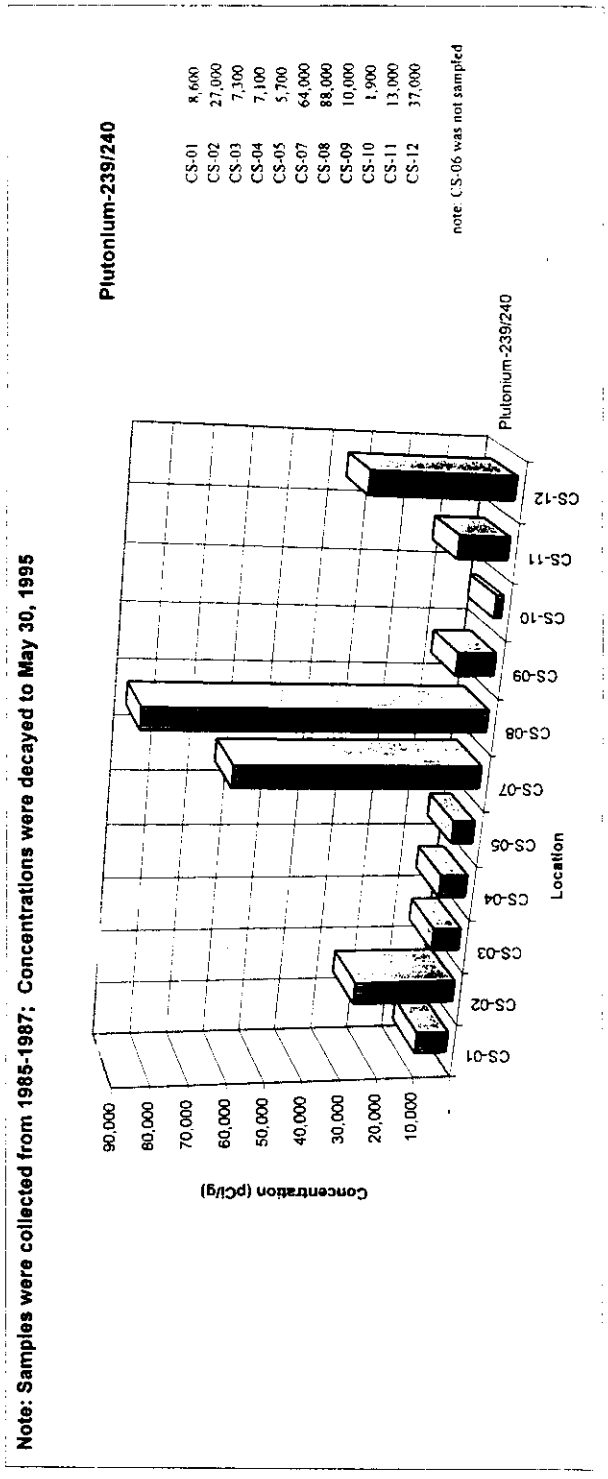


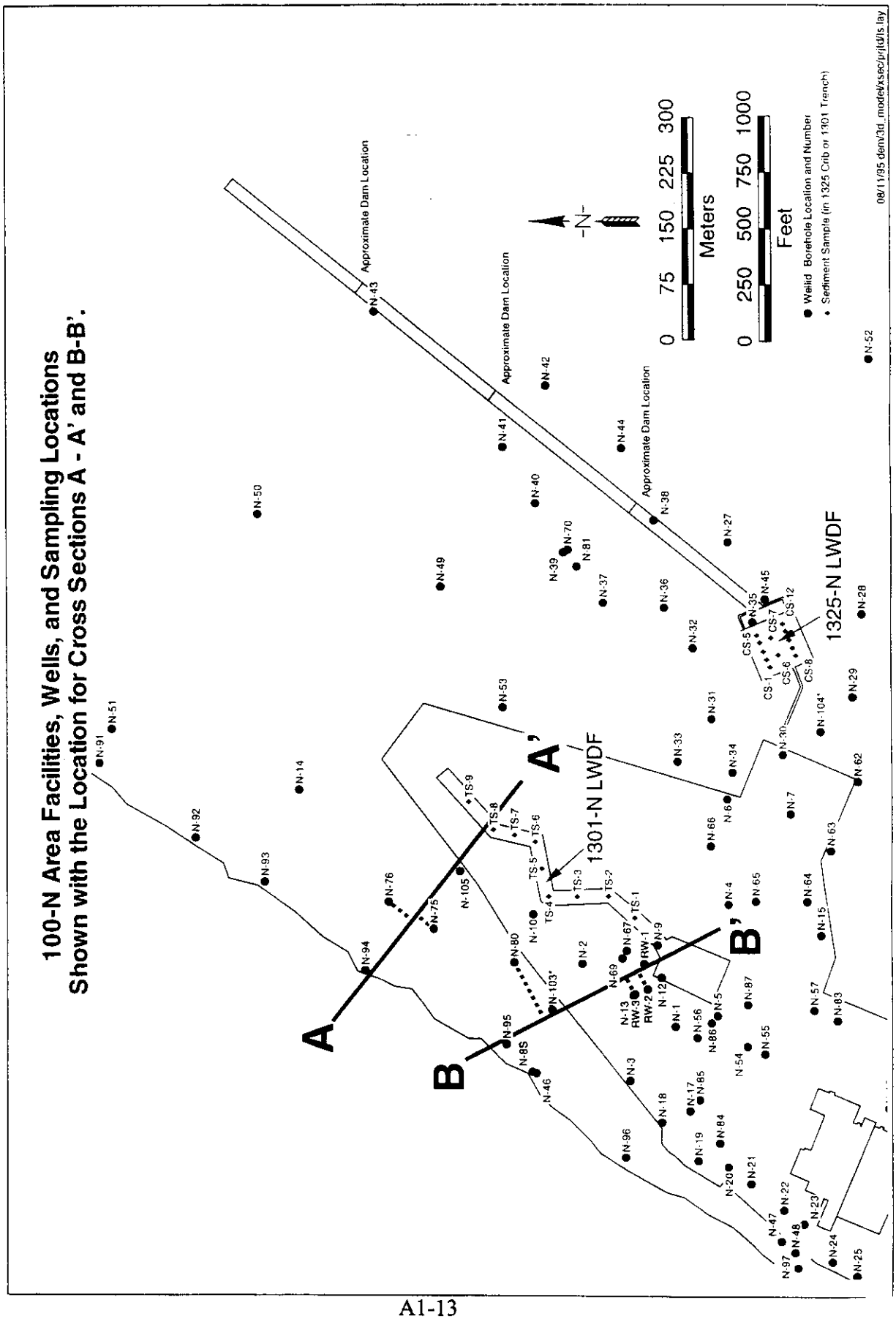
Figure A1-3. Average Concentrations In 1325-N Crib Decayed to May 30, 1995. (Page 2 of 2)





SOILS DATA
N SPRINGS AREA WELLS AND BOREHOLES

Figure A1-4. 100-N Area Facilities, Wells, and Sampling Locations Shown with the Location for Cross Sections A - A' and B - B'.



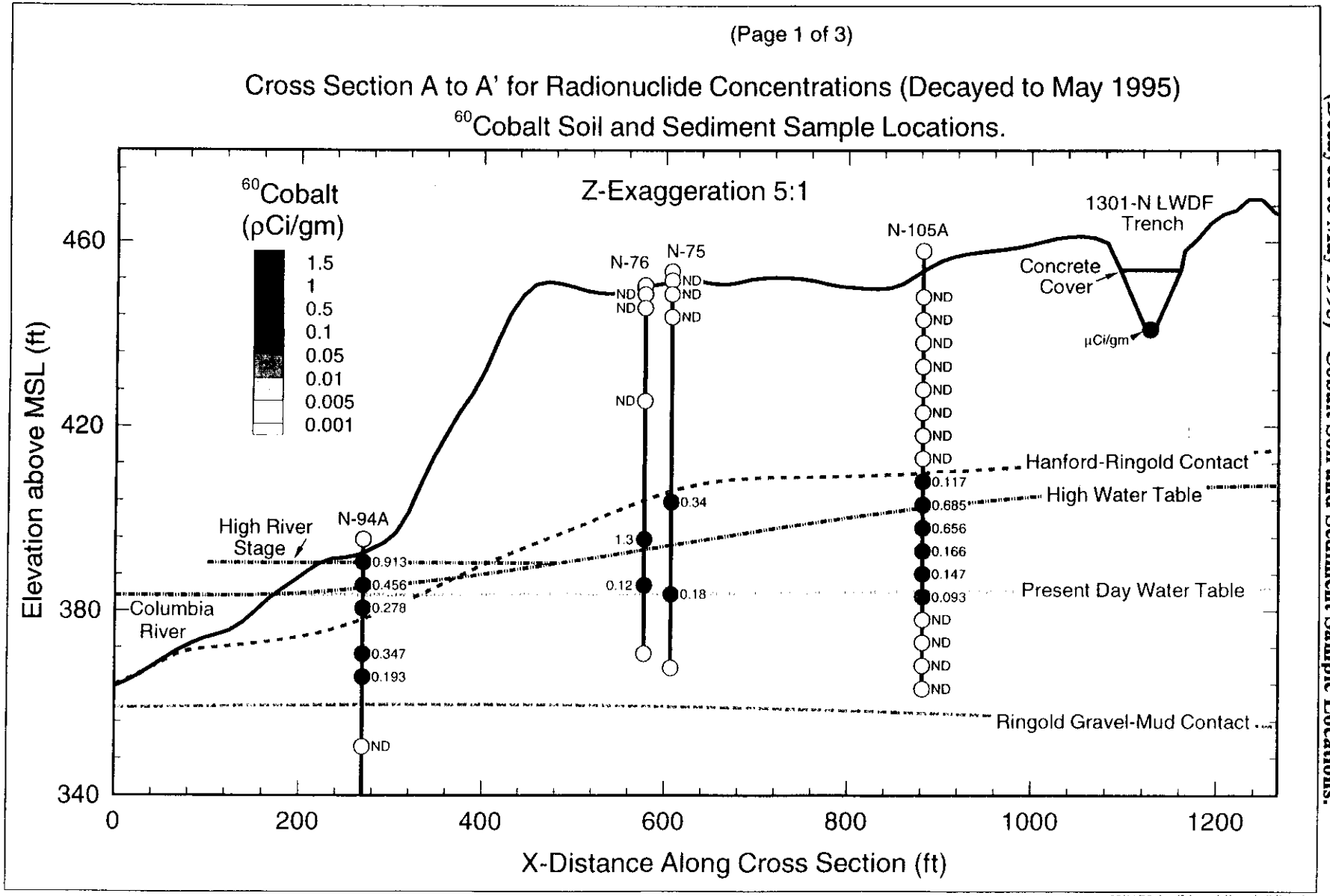


Figure A1-5. Cross Section A to A' for Radionuclide Concentrations (Decayed to May 1995) ^{60}Cobalt Soil and Sediment Sample Locations.

Figure A1-6. Cross Section A to A' for Radionuclide Concentrations (Decayed to May 1995) ^{137}Cesium Soil and Sediment Sample Locations.

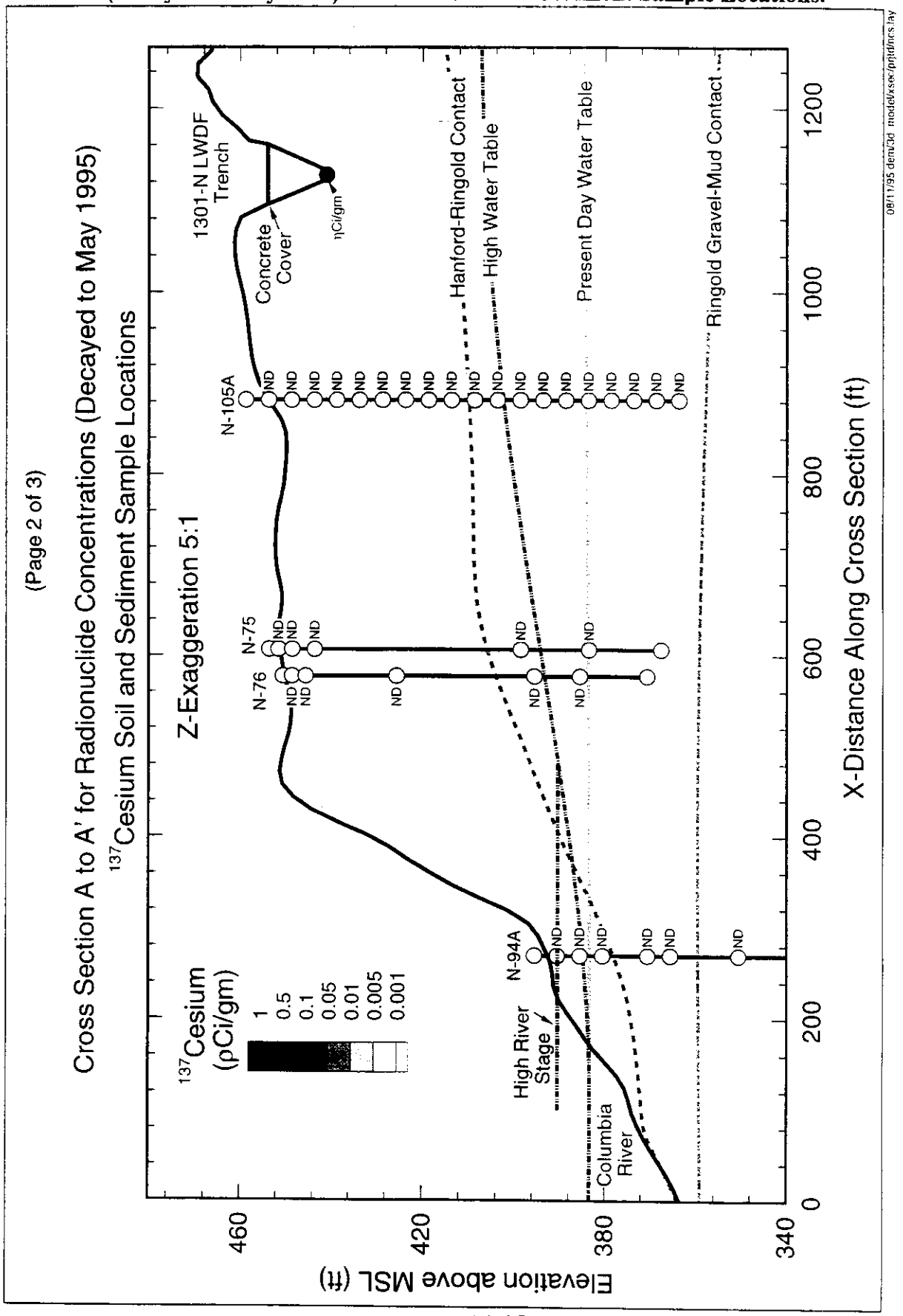


Figure A1-7. Cross Section A to A' for Radionuclide Concentrations (Decayed to May 1995) Strontium-90 Soil and Sediment Sample Locations.

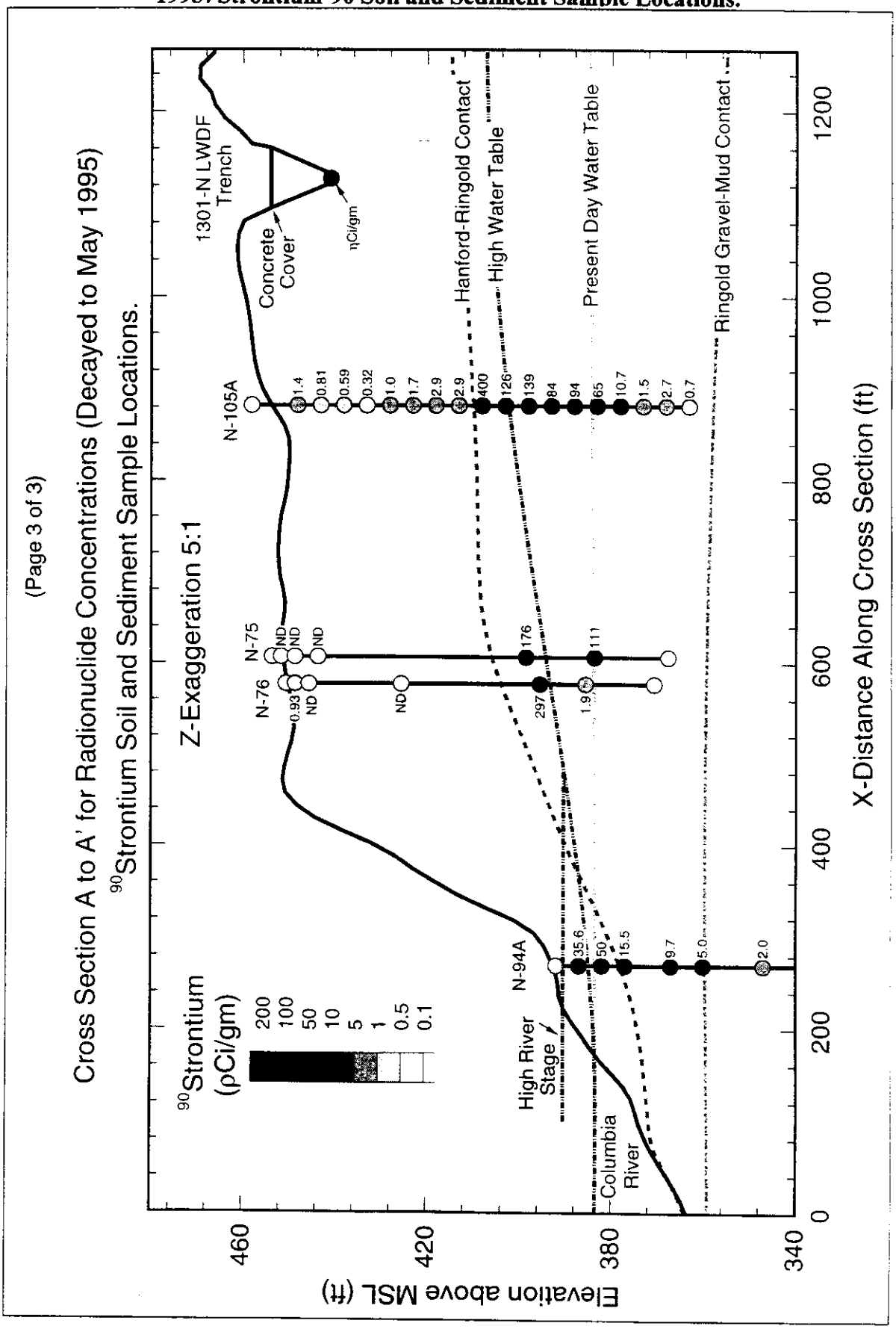


Figure A1-8. Cross Section B to B' for Radionuclide Concentrations (Decayed to May 1995) Cobalt-60 Soil and Sediment Sample Locations.

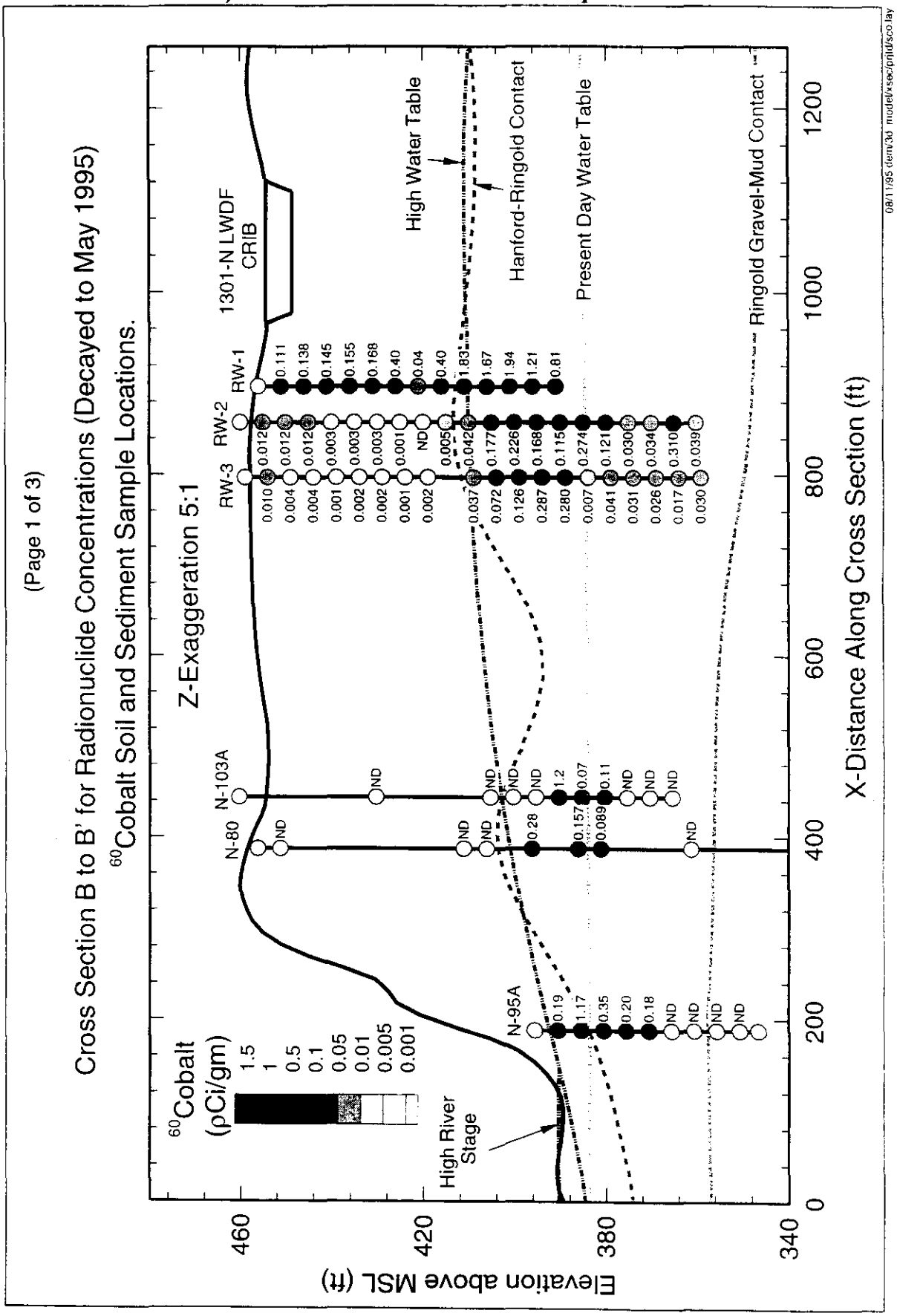


Figure A1-9. Cross Section B to B' for Radionuclide Concentrations (Decayed to May 1995) Cesium-137 Soil and Sediment Sample Locations.

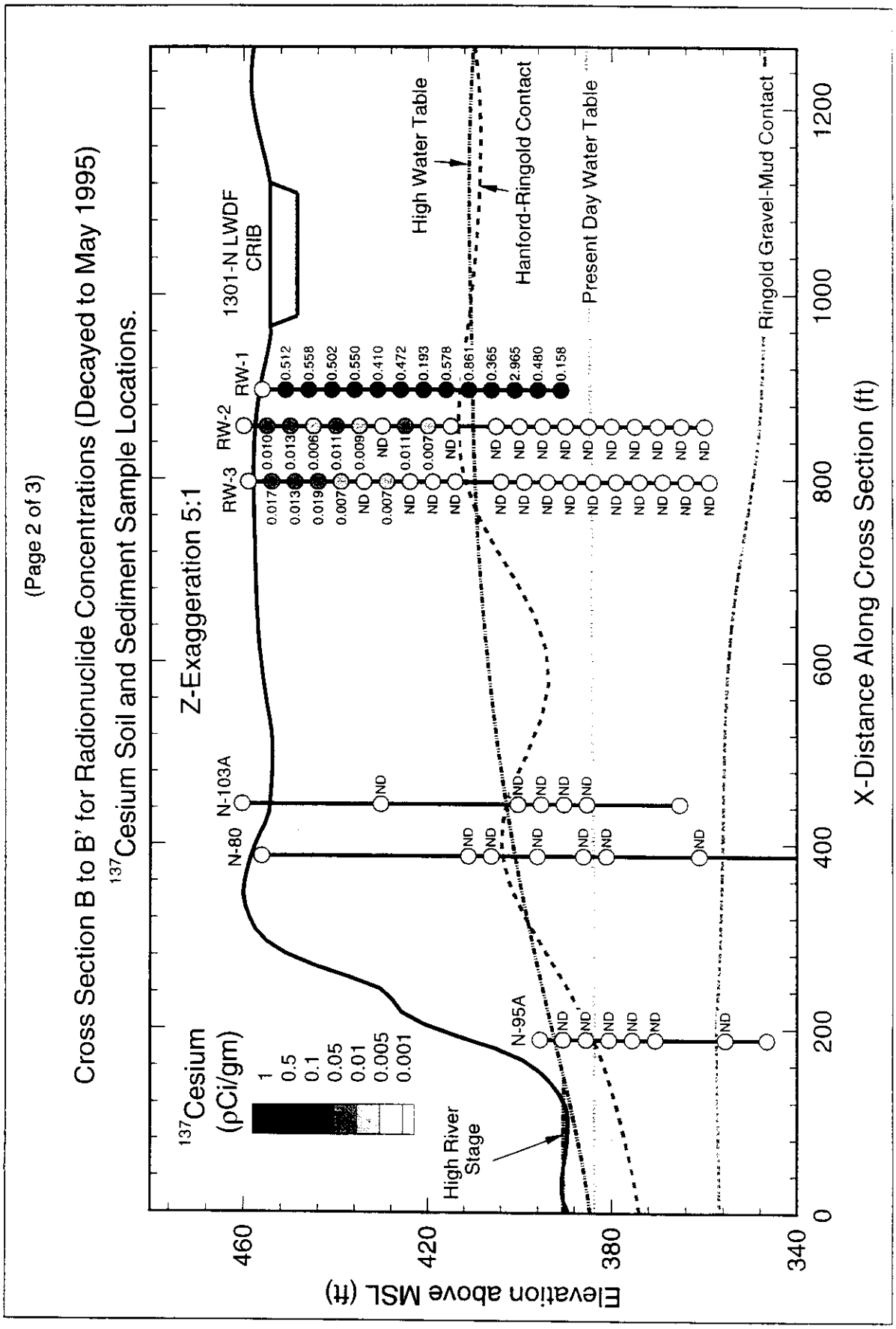


Figure A1-10. Cross Section B to B' for Radionuclide Concentrations (Decayed to May 1995) Strontium-90 Soil and Sediment Sample Locations.

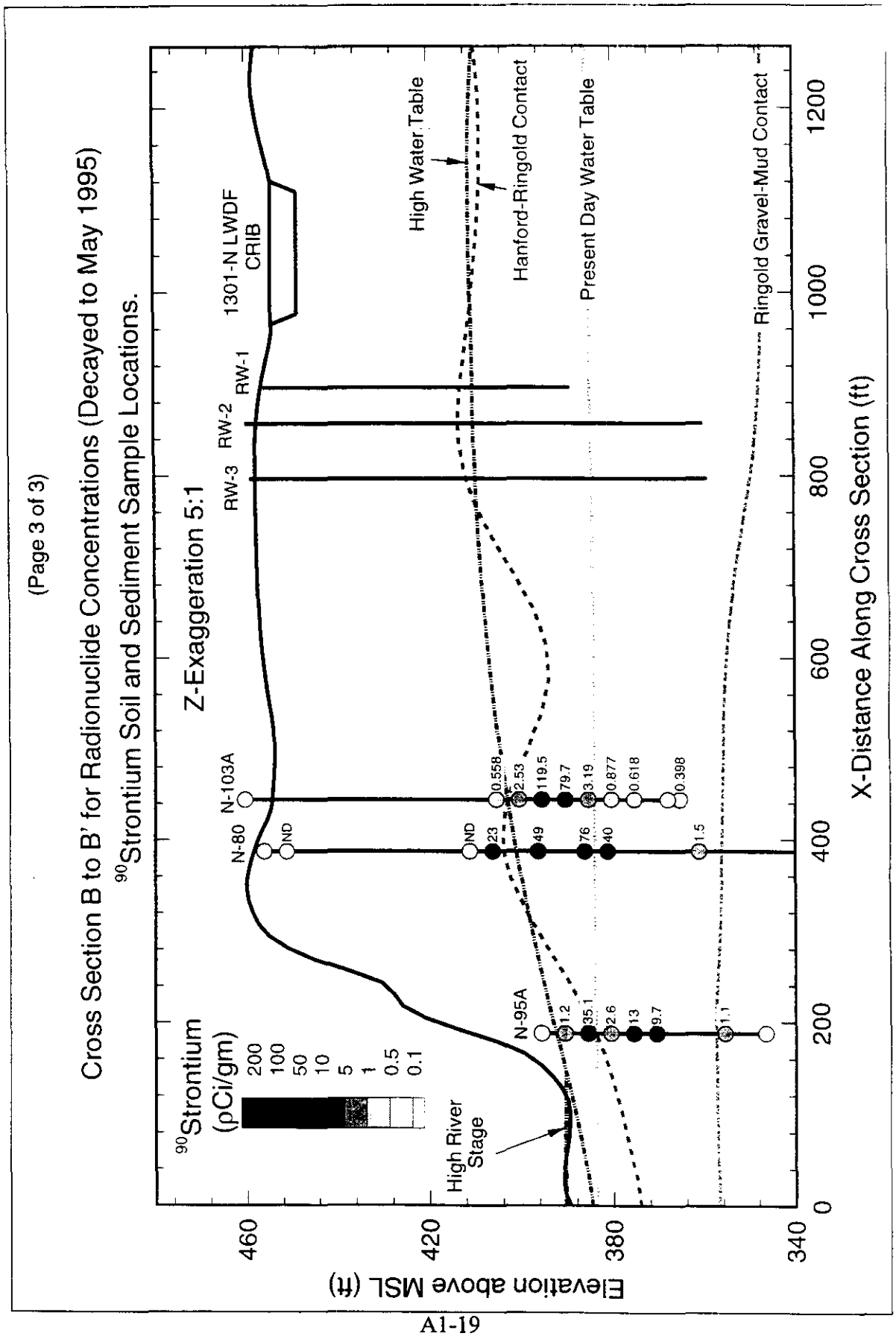


Table A1-1. Radionuclides Concentrations Detected in 1301-N Trench Sediment from 1980 to 1985 from Locations TS-01 to TS-09. (Page 1 of 2)

Location: / Analyte Units:	TS-01 pCi/g	TS-02 pCi/g	TS-03 pCi/g	TS-04 pCi/g	TS-05 pCi/g	TS-06 pCi/g	TS-07 pCi/g	TS-08 pCi/g	TS-09 pCi/g
Collection Date:					1980				
Gross alpha	NA	NA	NA	NA	NA	NA	NA	NA	NA
Gross beta	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cerium-144	11,000,000	4,100,000	1,100,000	800,000	510,000	860,000	410,000	ND	330,000
Europium-154	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cesium-134	NA	NA	NA	NA	41,000	NA	NA	NA	NA
Cesium-137	270,000	210,000	120,000	220,000	260,000	210,000	240,000	630,000	350,000
Cobalt-60	13,000,000	8,800,000	8,400,000	5,100,000	3,100,000	5,600,000	1,700,000	7,600,000	4,300,000
Cobalt-58	250,000		NA	NA	NA	NA	NA	NA	NA
Iron-59	NA	330,000	NA	NA	NA	NA	NA	NA	NA
Manganese-54	4,400,000	2,800,000	1,400,000	1,000,000	610,000	1,100,000	350,000	430,000	700,000
Niobium-95	3,600,000	1,500,000	220,000	260,000	140,000	270,000	92,000	ND	120,000
Plutonium-238	NA	NA	NA	NA	NA	NA	NA	NA	NA
Plutonium-239/240	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ruthenium-103	NA	110,000	NA	NA	NA	NA	NA	NA	NA
Ruthenium-106	2,700,000	870,000	NA	NA	NA	NA	NA	NA	NA
Strontium-90	NA	NA	NA	NA	NA	NA	NA	NA	NA
Zirconium-95	1,980,000	790,000	NA	NA	NA	NA	NA	NA	NA
Collection Date:					1981				
Gross alpha	NA	NA	NA	NA	NA	NA	NA	NA	NA
Gross beta	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cerium-144	2,700,000	1,100,000		1,200,000	440,000	770,000	840,000	790,000	110,000
Europium-154	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cesium-134	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cesium-137	190,000	190,000	530,000	330,000	490,000	570,000	530,000	440,000	780,000
Cobalt-60	6,600,000	6,300,000	19,000,000	6,000,000	4,400,000	17,000,000	8,900,000	5,400,000	8,300,000
Cobalt-58	NA	NA	NA	NA	NA	NA	NA	NA	NA
Iron-59	NA	NA	NA	NA	NA	NA	NA	NA	NA
Manganese-54	1,300,000	1,100,000	1,700,000	980,000	390,000	1,300,000	900,000	750,000	990,000
Niobium-95	140,000	90,000	NA	NA	NA	NA	NA	NA	NA
Plutonium-238	5,500	1,500	6,200	1,800	780	4,900	6,300	1,200	4,000
Plutonium-239/240	26,000	9,200	25,000	12,000	5,500	25,000	30,000	6,600	20,000
Ruthenium-103	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ruthenium-106	750,000	NA	NA	NA	NA	NA	NA	NA	NA
Strontium-90	170,000	770,000	110,000	36,000	21,000	96,000	110,000	25,000	45,000
Zirconium-95	NA	NA	NA	NA	NA	NA	NA	NA	NA
Collection Date:					1982				
Gross alpha	NA	NA	NA	NA	NA	NA	NA	NA	NA
Gross beta	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cerium-144	NA	2,100,000	NA	NA	NA	NA	NA	NA	1,300,000
Europium-154	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cesium-134	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cesium-137	940,000	490,000	940,000	530,000	540,000	500,000	1,000,000	460,000	560,000
Cobalt-60	21,000,000	27,000,000	34,000,000	6,400,000	6,600,000	15,000,000	14,000,000	4,500,000	4,300,000
Cobalt-58	NA	NA	NA	NA	NA	NA	NA	NA	NA
Iron-59	NA	NA	NA	NA	NA	NA	NA	NA	NA
Manganese-54	710,000	1,900,000	860,000	460,000	460,000	470,000	490,000	270,000	ND
Niobium-95	NA	NA	NA	NA	NA	NA	NA	NA	NA
Plutonium-238	5,500	14,000	29,000	510,000	120,000	9,300	3,800	9,500	1,100
Plutonium-239/240	28,000	63,000	170,000	2,800,000	660,000	44,000	17,000	16,000	13,000
Ruthenium-103	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ruthenium-106	NA	NA	NA	NA	NA	NA	NA	NA	NA
Strontium-90	110,000	250,000	320,000	150,000	110,000	230,000	83,000	70,000	150,000
Zirconium-95	NA	NA	NA	NA	NA	NA	NA	NA	NA

Table A1-1. Radionuclides Concentrations Detected in 1301-N Trench Sediment from 1980 to 1985 from Locations TS-01 to TS-09. (Page 2 of 2)

Location: / Analyte Units:	TS-01 pCi/g	TS-02 pCi/g	TS-03 pCi/g	TS-04 pCi/g	TS-05 pCi/g	TS-06 pCi/g	TS-07 pCi/g	TS-08 pCi/g	TS-09 pCi/g
Collection Date:	1983								
Gross alpha	NA	NA	NA	NA	NA	NA	NA	NA	NA
Gross beta	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cerium-144	NA	NA	NA	380,000	NA	NA	NA	NA	NA
Europium-154	130,000	ND	ND	54,000	80,000	170,000	ND	ND	ND
Cesium-134	ND	ND	ND	ND	28,000	ND	37,000	28,000	NA
Cesium-137	83,000,000	550,000	580,000	380,000	720,000	950,000	800,000	400,000	390,000
Cobalt-60	22,000,000	16,000,000	25,000,000	8,000,000	5,200,000	16,000,000	6,000,000	4,000,000	4,000,000
Cobalt-58	NA	NA	NA	NA	NA	NA	NA	NA	NA
Iron-59	NA	NA	NA	NA	NA	NA	NA	NA	NA
Manganese-54	610,000	410,000	620,000	940,000	130,000	300,000	140,000	170,000	220,000
Niobium-95	NA	NA	NA	120,000	NA	NA	NA	NA	NA
Plutonium-238	2,400	3,000	1,800	1,500	560	2,000	1,100	830	920
Plutonium-239/240	12,000	13,000	10,000	7,500	3,000	9,800	6,200	4,600	4,300
Ruthenium-103	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ruthenium-106	NA	NA	NA	NA	NA	NA	NA	NA	NA
Strontium-90	46,000	46,000	29,000	26,000	13,000	46,000	27,000	13,000	8,700
Zirconium-95	NA	NA	NA	NA	NA	NA	NA	NA	NA
Collection Date:	1984								
Gross alpha	NA	NA	NA	NA	NA	NA	NA	NA	NA
Gross beta	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cerium-144	NA	NA	NA	NA	NA	NA	870,000	NA	NA
Europium-154	NA	NA	NA	NA	150,000	NA	NA	NA	NA
Cesium-134	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cesium-137	3,100,000	960,000	820,000	750,000	1,300,000	750,000	980,000	730,000	1,300,000
Cobalt-60	53,000,000	22,000,000	32,000,000	16,000,000	8,300,000	23,000,000	16,000,000	16,000,000	15,000,000
Cobalt-58	NA	NA	NA	NA	NA	NA	NA	NA	NA
Iron-59	NA	NA	NA	NA	NA	NA	NA	NA	NA
Manganese-54	790000 U	470,000	520,000	1,300,000	190000 U	350,000	3,200,000	750,000	1,100,000
Niobium-95	NA	NA	NA	NA	NA	NA	NA	NA	NA
Plutonium-238	NA	NA	NA	NA	NA	NA	NA	NA	NA
Plutonium-239/240	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ruthenium-103	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ruthenium-106	NA	NA	NA	NA	NA	NA	NA	NA	NA
Strontium-90	NA	NA	NA	NA	NA	NA	NA	NA	NA
Zirconium-95	NA	NA	NA	NA	NA	NA	NA	NA	NA
Collection Date:	1985								
Gross alpha	35,000	28,000	52,000	38,000	34,000	42,000	19,000	18,000	28,000
Gross beta	1,900,000	19,000,000	13,000,000	6,500,000	5,000,000	10,000,000	6,000,000	2,800,000	2,300,000
Cerium-144	87000 U	67000 U	84000 U	85000 U	69000 U	79000 U	50,000	11000 U	63000 U
Europium-154	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cesium-134	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cesium-137	29,000	26,000	37,000	28,000	55,000	68,000	56,000	22,000	25,000
Cobalt-60	1,300,000	1,100,000	1,600,000	1,200,000	950,000	1,100,000	1,300,000	260,000	640,000
Cobalt-58	NA	NA	NA	NA	NA	NA	NA	NA	NA
Iron-59	NA	NA	NA	NA	NA	NA	NA	NA	NA
Manganese-54	54,000	17,000	23000 U	100,000	56,000	18000 U	150,000	28,000	40,000
Niobium-95	NA	NA	NA	NA	NA	NA	NA	NA	NA
Plutonium-238	4,600	2,900	5,100	4,000	3,900	4,200	2,300	1,800	3,400
Plutonium-239/240	26,000	16,000	27,000	23,000	21,000	24,000	14,000	11,000	20,000
Ruthenium-103	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ruthenium-106	NA	NA	NA	NA	NA	NA	NA	NA	NA
Strontium-90	93,000	77,000	210,000	110,000	190,000	120,000	120,000	70,000	110,000
Zirconium-95	NA	NA	NA	NA	NA	NA	NA	NA	NA

U = Table indicates not detected at specified detection limit. However, the reference indicates the sample was less than the concentration indicated.
NA = Not analyzed
ND = Not detected; no detection limit given

References:
UNI-1581 = Radiological Surveillance Report for the 100-N Areat-FY1980
UNI-1849 = UNC Environmental Surveillance Report for the 100 Areas-FY1981.
UNI-2226 = UNC Environmental Surveillance Report for the 100 Areas-FY1982.
UNI-2640 = UNC Environmental Surveillance Report for the 100 Areas-FY1983.
UNI-3069 = UNC Environmental Surveillance Report for the 100 Areas-FY1984.
UNI-3760 = UNC Environmental Surveillance Report for the 100 Areas-FY1985.

Table A1-2. Radionuclide Concentrations Detected in 1325-N Crib Sediments from 1985 to 1987 from Locations CS-01 to CS-12.

Location: / Analyte: Units:	CS-01 pCi/g	CS-02 pCi/g	CS-03 pCi/g	CS-04 pCi/g	CS-05 pCi/g	CS-06 pCi/g	CS-07 pCi/g	CS-08 pCi/g	CS-09 pCi/g	CS-10 pCi/g	CS-11 pCi/g	CS-12 pCi/g
Collection Date:	1985											
Gross alpha	18,000	7,000	18,000	6,000	4,700	NR	44,000	26,000	18,000	12,000	9,700	6,100
Gross beta	2,300,000	3,100,000	1,600,000	830,000	400,000	NR	15,000,000	2,400,000	2,200,000	1,100,000	1,500,000	620,000
Cerium-144	120,000	64,000	94,000	41,000	5,800	NR	100000 U	100,000	15,000	67,000	76,000	40,000
Cesium-137	41,000	49,000	49,000	35,000	13,000	NR	11,000	29,000	5,000	58,000	48,000	71,000
Cobalt-60	1,300,000	660,000	1,100,000	600,000	180,000	NR	1,600,000	1,700,000	140,000	520,000	800,000	580,000
Manganese-54	270,000	190,000	280,000	160,000	52,000	NR	260,000	360,000	32,000	150,000	240,000	170,000
Plutonium-238	2,000	740	2,000	660	460	NR	5,000	8,600	1,800	350	1,100	530
Plutonium-239/240	12,000	5,000	13,000	4,300	2,800	NR	30,000	56,000	12,000	2,300	6,900	34,000
Strontium-90	88,000	26,000	89,000	27,000	15,000	NR	200,000	100,000	17,000	13,000	12,000	5,800
Collection Date:	1986											
Gross alpha	NR	NR	NA	NA	NA	NR	NR	NA	NA	NR	NR	NR
Gross beta	NR	NR	NA	NA	NA	NR	NR	NA	NA	NR	NR	NR
Cerium-144	770,000	34,000	86,000	130,000	55,000	NR	NR	120,000	130,000	NR	NR	NR
Cesium-137	180,000	62,000	88,000	85,000	92,000	NR	NR	66,000	80,000	NR	NR	NR
Cobalt-60	9,100,000	520,000	2,300,000	2,500,000	620,000	NR	NR	1,700,000	2,800,000	NR	NR	NR
Manganese-54	1,600,000	140,000	380,000	480,000	170,000	NR	NR	310,000	510,000	NR	NR	NR
Plutonium-238	NA	NA	NA	NA	NA	NR	NR	NA	NA	NR	NR	NR
Plutonium-239/240	NA	NA	NA	NA	NA	NR	NR	NA	NA	NR	NR	NR
Strontium-90	9,100	3,900	5,000	5,000	3,400	NR	NR	NR	9,200	NR	NR	NR
Collection Date:	1987											
Gross alpha	NA	NA	NA	NA	NA	NR	NA	NA	NA	NA	NA	NA
Gross beta	NA	NA	NA	NA	NA	NR	NA	NA	NA	NA	NA	NA
Cerium-144	60000 U	91000 U	35000 U	53000 U	58000 U	NR	98000 U	81000 U	46000 U	16000 U	73000 U	83000 U
Cesium-137	32,000	17000 U	18,000	29,000	30,000	NR	48,000	15,000	17,000	21,000	13,000	13,000
Cobalt-60	820,000	1,400,000	630,000	630,000	680,000	NR	1,300,000	1,100,000	820,000	140,000	840,000	1,200,000
Manganese-54	130,000	200,000	97,000	96,000	100,000	NR	270,000	120,000	120,000	31,000	130,000	140,000
Plutonium-238	1,100	6,700	250	1,400	1,300	NR	17,000	21,000	1,300	2,300	3,100	6,000
Plutonium-239/240	5,200	49,000	1,600	9,900	8,500	NR	98,000	120,000	8,300	1,400	20,000	39,000
Strontium-90	14,000	40,000	5,900	4,300	10,000	NR	630,000	270,000	10,000	14,000	29,000	35,000

U = Not detected at specified detection limit

NR = Not reported

NA = Not analyzed

NS = Not sampled

Reference:

UNI-3760 = UNC Environmental Surveillance Report for the 100 Areas - FY 1985

UNI-4065 = UNC Environmental Surveillance Report for the100 Areas - FY 1986

WHC-EP-0161 = Westinghouse Hanford Co. Environmental Surveillance Annual Report-100 Areas-FY 1987

Table A1-3. Semivolatile Organics Compounds Detected in 1325-N Crib Sediments in April 1989.

Location:	Sediment Concentration (ug/kg)																					
Sample ID:	A		B		C		D		E		F		G		H		I		J		K		method blank	
Phenol		ND		ND		ND		ND	480			ND		ND		ND		ND		ND		ND		ND
bis(2-chloroisopropyl) ether		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	22	JB
Nitrobenzene		ND		ND		ND		ND	34	J		ND		ND		ND		ND		ND		ND		ND
Isophorone		ND		ND		ND		ND	91	J		ND		ND		ND		ND		ND		ND		ND
2,4-Dimethylphenol		ND		ND		ND		ND	58	J		ND		ND		ND		ND		ND		ND		ND
2,4-Dichlorophenol		ND		ND		ND		ND	78	J		ND		ND		ND		ND		ND		ND		ND
Naphthalene		ND		ND		ND		ND	42	J		ND		ND		ND		ND		ND		ND		ND
2-Methylnaphthalene		ND		ND		ND		ND	22	J		ND		ND		ND		ND		ND		ND		ND
Dimethylphthalate		ND		ND		ND		ND	510			ND		ND		ND		ND		ND		ND		ND
Acenaphthylene		ND		ND		ND		ND	14	J		ND		ND		ND		ND		ND		ND		ND
Acenaphthene		ND		ND		ND		ND	40	J		ND		ND		ND		ND		ND		ND		ND
Dibenzofuran		ND		ND		ND		ND	30	J		ND		ND		ND		ND		ND		ND		ND
Diethylphthalate		ND		ND		ND		ND	92	J		ND		ND		ND		ND		ND		ND		ND
Fluorene		ND		ND		ND		ND	35	J		ND		ND		ND		ND		ND		ND		ND
Di-n-butylphthalate	28	J		ND		ND	12	J	2600		22	J	17	J	22	J	27	J	110	J	410	J		ND
Fluoranthene		ND		ND		ND	15	J	230	J		ND		ND	9	J		ND		ND	13	J		ND
Pyrene		ND		ND		ND	18	J	430			ND		ND	14	J		ND	11	J	22	J		ND
Butylbenzylphthalte	24	J	22	J	26	J	28	J		ND	23	J	40	J	46	J	28	J		ND		ND		ND
Benzo(a)anthracene		ND		ND		ND	15	J	340			ND		ND		ND		ND		ND		ND		ND
Chrysene		ND		ND		ND	15	J	370			ND		ND		ND		ND		ND		ND		ND
bis(2-Ethylhexyl)phthalate	400	B	440	B	250	JB	450	B	3800	B	830	B	720	B	840	B	600	B	340	B	540	B	450	B
Di-n-octylphthalte	330	B	13	JB	18	JB	22	JB	5200	B	100	JB	26	JB	19	JB	63	JB	25	JB	22	JB	54	JB
4-Methyl-2-Pentanone		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
N-Nitrosodiphenylamine (1)		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND

Samples analyzed by Method SW-846. Chemicals that were analyzed for but not detected in any of the samples were not listed in this table.

ND = Not detected. Reference document does not present detection limit.

J = The associated numerical value is an estimated quantity.

B = The analyte is found in the associated blank as well as the sample.

JB = Analyte found in associated blank at estimated concentration.

Samples labeled A -F were collected from the 1325-N manholes - exact location not reported

Reference: DOE/RL-93-80, Rev 0

Table A1-4. Inorganics Compounds Detected in 1325-N Crib Sediments in 1989.

Sample ID:	1	A	B	C	D	E	F	G	H	I	J	J (dup)	K
Analyte: Units:	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Aluminum	ND	3,500	3,100	5,650	5,150	4,400	5,100	5,150	4,100	4,200	4,700	4,450	5,550
Arsenic	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Barium	220	83	65	126	95	220	116	110	109	99	100	100	109
Beryllium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Cadmium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Calcium	22,000	6,950	3,950	22,000	5,350	10,300	6,100	6,300	5,250	5,150	5,050	5,250	8,000
Chromium	450	ND	ND	ND	ND	450	ND	ND	30 J	ND	ND	ND	20 J
Cobalt	15	ND	ND	ND	ND	ND	ND	ND	ND	ND	15 J	10 J	ND
Copper	230	80 J	20 J	40 J	40 J	230	30 J	40 J	40 J	30 J	40 J	30 J	10 J
Iron	135,000	28,700	21,900	26,700	31,800	135,000	36,000	37,300	30,000	29,000	31,800	32,300	29,800
Lead	500	ND	ND	ND	ND	500 J	ND	ND	ND	ND	ND	ND	ND
Magnesium	8,950	4,650	3,800	8,950	5,400	3,200	5,450	5,850	4,000	4,600	4,450	4,750	6,601
Manganese	920	370	230	505	370	920	370	370	280	530	330	350	480
Mercury	1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Nickel	200	ND	20 J	50 J	30 J	200 J	30 J	30 J	50 J	30 J	30 J	30 J	50 J
Phosphorus	2,400	1,700 J	800 J	2,100 J	1,200 J	2,400 J	1,200 J	1,000 J	1,000 J	1,000 J	1,100 J	1,000 J	1,000 J
Potassium	500	280 J	280 J	500 J	450 J	250 J	400 J	450 J	350 J	400 J	500 J	450 J	400 J
Silver	ND	450	470	430	330	380	500	500	320	300	500	330	300
Sodium	430	270 J	270 J	430 J	350 J	300 J	360 J	370 J	320 J	330 J	310 J	350 J	350 J
Strontium	45	25	15	42	25	45	24	23	21	19	19	21	25
Thallium	3,350	1,650	1,900	2,200	2,700	620	3,350	2,850	1,750	2,680	2,600	2,100	2,150
Vanadium	100	40	50	70	80	20 J	100	100	60	80	80	70	60
Zinc	1,650	60	90	240	150	1,650	230	250	200	130	190	170	290
Zirconium	40	10 J	20 J	40 J	30 J	20 J	10 J	20 J	40 J	40 J	30 J	30 J	30 J

Sample ID number 1 was given this ID for this table. The reference document did not list a sample ID number.

Samples analyzed by EPA Method EPA6010

ND = Table indicates not detected values at specified detection level. However, the reference document indicates the sample was less than the concentration indicated.

J = The associated value is an estimated quantity.

Reference: WHC-SD-EN-DP-056, Rev. 0-A

Table A1-5. Concentrations Detected in Soil Located Near 1301-N/1325-N. (Page 1 of 8)

Ref. Doc.:	WHC/HEIS					WHC/HEIS					
Location:	199-N-75					199-N-76					
Sample ID:	B06837	B06838	B06839	B06843	B06845	B06835	B06836	B06840	B06841	B06842	B06844
Collection Date:	Apr-92					Apr-92					
Analyte: Depth (ft):	2-3	5-6	9	56-58	68-70	2-3	5-6	24-25	24-25	55-57	64.5-66.5
Gross alpha	3.1 U	1.9 U	8.5 U	-0.12 U	0.87 U	3.5 J	1.8 U	-0.94 U	5.3 U	5.9 U	0.65 U
Gross beta	12 J	8.7 J	37	430	250	18	8.6	14 J	36	650	23
Tritium	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Carbon-14	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Uranium-233/234	NR	NR	NR	0.62	0.69	NR	NR	NR	NR	1.2	0.4 U
Uranium-235	0.046 U	0.03 U	0.024 U	-0.026 U	0.11 U	0.08 U	0.021 U	0.1 U	0.047 U	0.12 U	0.25 U
Uranium-238	0.53	0.5	0.73	0.47	0.18 U	0.53	0.46	0.53	0.52	0.49	0.54
Plutonium - 238	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Plutonium-239/240	0.007 U	0.003 U	0.002 U	-0.007 U	0.002 U	0.004 U	-0.003 U	-0.002 U	0.004 U	0.003 U	-0.002 U
Americium-241	0.003 U	0.016 U	0.006 U	0.006 U	0.002 U	-0.004 U	0.029 U	-0.007 U	-0.004 U	0.011 U	-0.005 U
Strontium-90	0.11 U	-1.6 U	-1.077 U	190.0	120.0	0.17 U	0.04 U	0.045 U	0.13 U	320.0	2.0
Technetium-99	0.44 J	0.74 U	0.19 U	-0.055 U	0.52 U	1.0	0.1 U	0.43 J	0.24 U	0.13 U	0.11 U
Gamma Scan											
Potassium-40	10.0	1.1	9.4	13.0	12.0	9.4	9.3	8.8	7.6	13.0	12.0
Iron-59	NR	NR	NR	0.52 U	0.43 U	NR	NR	NR	NR	0.68	0.46 U
Manganese-54	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Chromium 51	5.9 U	6.6 U	6.5 U	3.8 U	3.5 U	7 U	4.5 U	6 U	6.1 U	6 U	2.4 U
Cobalt-60	0.088 U	0.072 U	0.12 U	0.52	0.28	0.13 U	0.1 U	0.13 U	0.13 U	1.2	0.18
Zinc-65	0.29 U	0.24 U	0.3 U	0.15 U	0.13 U	0.33 U	0.21 U	0.27 U	0.3 U	0.22 U	0.13 U
Ruthenium-103	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.35 U
Ruthenium-106	NR	NR	NR	0.46 U	0.39 U	NR	NR	NR	NR	0.65 U	0.043 U
Cesium-134	0.12 U	0.11 U	0.13 U	0.052 U	0.075 U	0.12 U	0.095 U	0.16 U	0.12 U	0.077 U	0.033 U
Cesium-137	0.095 U	0.096 U	0.095 U	0.046 U	0.034 U	0.10 U	0.06 U	0.099 U	0.1 U	0.57 U	0.078 U
Europium-152	NR	NR	NR	0.18 U	0.15 U	NR	NR	NR	NR	0.23 U	0.057 U
Europium-154	NR	NR	NR	0.1 U	0.097 U	NR	NR	NR	NR	0.15 U	NR
Radium-226	0.18 U	0.35	0.49	0.35	0.35	0.27	0.26	0.35	0.43	0.43	0.4
Thorium-228	0.55	0.7	0.67	0.47	0.59	0.62	0.41	0.52	0.59	0.59	0.5
Thorium-232	0.42	0.52	0.72	0.39	0.62	0.69	0.43	0.52 U	0.53 U	0.41	0.46
Lead-214	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Tin-125	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Concentrations in pCi/g.

Table A1-5. Concentrations Detected in Soil Located Near 1301-N/1325-N. (Page 2 of 8)

Ref. Doc.:	HEIS							BHI-00135					
Location:	199-N-80							199-N-94A					
Sample ID:	B06M60	B06M37	B06M62	B072P4	B072P5	B072P7	B072P9						
Collection Date:	Jul-92							Oct-94					
Analyte Depth (ft):	45-47	50-52	50-52 dup	57-59	68-70	75-77	95.7-99	5	10	15	25	30	45
Gross alpha	8.8 R	3 R	6.9 R	0.75 R	4.2 R	4.9 R	0.34 R	ND	ND	ND	ND	ND	ND
Gross beta	19	62	NA	130	200	93	20	ND	ND	ND	ND	ND	ND
Tritium	NA	NA	NA	NA	NA	NA	NA	0.324	1.71	3.8	7.34	6.58	0.448
Carbon-14	3.9 U	3.1 U	4.2 U	-2.7 U	-6.3 U	0.28 U	1.6 U	ND	ND	ND	ND	ND	ND
Uranium-233/234	0.38 R	0.32 R	0.18 R	33	0.36	0.37	0.33	ND	ND	ND	ND	ND	ND
Uranium-235	0 R	0 R	-0.036 R	0.017 U	0 R	0.025 R	0.032 R	ND	ND	ND	ND	ND	ND
Uranium-238	0.48 R	0.27 R	0.21 R	0.38 R	0.35	0.35	0.27	ND	ND	ND	ND	0.275	ND
Plutonium - 238	0.002 U	-0.012 U	0.015 U	-0.009 U	0.004 R	0.004 U	-0.003 U	ND	ND	ND	ND	ND	ND
Plutonium-239/240	0 U	0.004 U	0.002 U	-0.003 U	0.008 R	0.002 U	-0.003 U	ND	ND	ND	ND	ND	ND
Americium-241	0.003 U	0.007 U	-0.012 U	0.007 U	0.009 U	0.006 U	0 U	ND	ND	ND	ND	ND	ND
Strontium-90	0.3 UJ	28 J	25 J	52	81	43	1.6	36.2	51.0	15.7	9.9	5.1	2.0
Technetium-99	NA	NA	NA	NA	NA	NA	NA	ND	ND	ND	ND	ND	ND
Gamma Scan													
Potassium-40	13.0	8.6	9.0	12.0	13.0	14.0	12.0	20.4	25.3	23.0	24.8	23.2	28.2
Iron-59	0.33 U	0.36 U	0.42 U	0.61 U	0.21 U	0.22 U	0.2 U	ND	ND	ND	ND	ND	ND
Manganese-54	NA	NA	NA	NA	NA	NA	NA	ND	ND	ND	ND	ND	ND
Chromium 51	1.2 U	1.7 U	1.4 U	2.1 U	1.1 U	0.75 U	0.72 U	ND	ND	ND	ND	ND	ND
Cobalt-60	0.064 U	0.2 U	0.17 U	0.41	0.23	0.13	0.045 U	0.996	0.497	0.30	0.38	0.21	ND
Zinc-65	0.18 U	0.35 U	0.29 U	0.31 U	0.11 U	0.12 U	0.1 U	ND	ND	ND	ND	ND	ND
Ruthenium-103	NA	NA	NA	NA	NA	NA	NA	ND	ND	ND	ND	ND	ND
Ruthenium-106	0.5 U	0.88 U	0.87 U	0.89 U	0.4 U	0.35 U	0.31 U	ND	ND	ND	ND	ND	ND
Cesium-134	0.056 U	0.13 U	0.11 U	0.12 U	0.052 U	0.048 U	0.04 U	0.308	0.195	0.537	3.953	ND	1.035
Cesium-137	0.053 U	0.094 U	0.1 U	0.12 U	0.044 U	0.037 U	0.037 U	ND	ND	ND	ND	ND	ND
Europium-152	0.1 U	0.2 U	0.19 U	0.24 U	0.15 U	0.093 U	0.083 U	ND	ND	ND	ND	ND	ND
Europium-154	0.068 U	0.13 U	0.12 U	0.17 U	0.098 U	0.068 U	0.055 U	ND	ND	ND	ND	ND	ND
Radium-226	0.51	0.49	NA	0.27	0.34	0.43	0.4	ND	ND	ND	ND	ND	ND
Thorium-228	1.1	0.64	0.47	0.49	0.63	0.75	0.81	ND	ND	ND	ND	ND	ND
Thorium-232	0.67	0.57 U	0.77 U	0.58 U	0.59	0.8	0.62	0.758	0.858	0.857	1.022	0.894	1.644
Lead-214	NA	NA	NA	NA	NA	NA	NA	ND	ND	ND	ND	ND	ND
Tin-125	NA	NA	NA	NA	NA	NA	NA	0.809	1.069	0.996	1.139	1.058	2.291

Concentrations in pCi/g.

Table A1-5. Concentrations Detected in Soil Located Near 1301-N/1325-N. (Page 3 of 8)

Ref. Doc.:	BHI-00135								HEIS	SERNE	HEIS	SERNE
Location:	199-N-95A								199-N-103A			
Sample ID:									B0DRK7		B0DRK8	
Collection Date:	Sep-94								Apr-95			
Analyte: Depth (ft):	5	10	15	20	25	30	35	40	29-32	55	59-60.5	60
Gross alpha	ND	ND	ND	ND	ND	ND	ND	ND	NA	NA	NA	NA
Gross beta	ND	ND	ND	ND	ND	ND	ND	ND	NA	NA	NA	NA
Tritium	0.196	0.052	2.88	2.3	0.952	ND	ND	11.8	281	NA	127000	NA
Carbon-14	ND	ND	ND	ND	ND	ND	ND	ND	NA	NA	NA	NA
Uranium-233/234	ND	ND	ND	ND	ND	ND	ND	ND	NA	NA	NA	NA
Uranium-235	ND	ND	ND	ND	ND	ND	ND	ND	NA	NA	NA	NA
Uranium-238	ND	ND	ND	ND	ND	ND	ND	ND	0.518	NA	NA	NA
Plutonium - 238	ND	ND	ND	ND	ND	ND	ND	ND	NA	NA	NA	NA
Plutonium-239/240	ND	ND	ND	ND	ND	ND	ND	ND	NA	NA	NA	NA
Americium-241	ND	ND	ND	ND	ND	ND	ND	ND	NA	NA	NA	NA
Strontium-90	1.3	37.8	2.8	14.0	10.5	ND	ND	1.2	0.0399 U	0.56	2.26	2.54
Technetium-99	ND	ND	ND	ND	ND	ND	ND	ND	NA	NA	NA	NA
Gamma Scan												
Potassium-40	21.8	22.6	19.7	18.5	19.5	ND	ND	19.0 D	15.4	NA	15.4	NA
Iron-59	ND	ND	ND	ND	ND	ND	ND	ND	0.00291 U	NA	0.00459 U	NA
Manganese-54	ND	ND	ND	ND	ND	ND	ND	ND	NA	NA	NA	NA
Chromium 51	ND	ND	ND	ND	ND	ND	ND	ND	NA	NA	NA	NA
Cobalt-60	0.206	1.29	0.39	0.22	0.19	ND	ND	ND	0.00186 U	NA	0.149 U	NA
Zinc-65	ND	ND	ND	ND	ND	ND	ND	ND	NA	NA	NA	NA
Ruthenium-103	ND	ND	ND	ND	ND	ND	ND	ND	NA	NA	NA	NA
Ruthenium-106	ND	ND	ND	3.953	ND	ND	ND	ND	NA	NA	NA	NA
Cesium-134	NR	NR	0.402	0.392	NR	ND	ND	0.617	NA	NA	NA	NA
Cesium-137	ND	ND	ND	ND	ND	ND	ND	ND	0.00079 U	NA	0.0159 J	NA
Europium-152	ND	ND	ND	ND	ND	ND	ND	ND	0.00459 U	NA	0.00334 U	NA
Europium-154	ND	ND	ND	ND	ND	ND	ND	ND	0.0141 U	NA	-0.005 U	NA
Radium-226	ND	ND	ND	ND	ND	ND	ND	ND	0.452	NA	0.368	NA
Thorium-228	ND	ND	ND	ND	ND	ND	ND	ND	NA	NA	NA	NA
Thorium-232	0.673	0.647	0.789	0.632	0.617	ND	ND	0.778	NA	NA	NA	NA
Lead-214	ND	ND	ND	ND	ND	ND	ND	ND	NA	NA	NA	NA
Tin-125	0.76	0.734	1.233	0.724	0.746	ND	ND	1.163	NA	NA	NA	NA

Concentrations in pCi/g.

Table A1-5. Concentrations Detected in Soil Located Near 1301-N/1325-N. (Page 4 of 8)

Ref. Doc.:	HEIS	SERNE	SERNE	SERNE	HEIS	SERNE	SERNE	SERNE				
Location:	199-N-103A continued								RESEARCH WELL #1			
Sample ID:	B0DRK9				B0DRL0							
Collection Date:	Apr-95								Aug-82			
Depth (ft):	65-67	65	70	75	77-78.5	80	85	95	5	10	15	20
Gross alpha	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Gross beta	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Tritium	84600	NA	NA	NA	59400	NA	NA	NA	NA	NA	NA	NA
Carbon-14	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Uranium-233/234	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Uranium-235	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Uranium-238	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Plutonium - 238	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Plutonium-239/240	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Americium-241	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Strontium-90	153	120	80	3.2	0.976 J	0.88	0.62	0.4	NA	NA	NA	NA
Technetium-99	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Gamma Scan												
Potassium-40	16.2	NA	NA	NA	9.47	NA	NA	NA	9.30	10.30	10.30	7.58
Iron-59	-0.035 U	NA	NA	NA	-0.006 U	NA	NA	NA	NA	NA	NA	NA
Manganese-54	NA	NA	NA	NA	NA	NA	NA	NA	0.063	0.043	0.053	0.05
Chromium 51	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cobalt-60	0.617 U	NA	NA	NA	0.0678 U	NA	NA	NA	0.598	0.745	0.779	0.836
Zinc-65	NA	NA	NA	NA	NA	NA	N	NA	NA	NA	NA	NA
Ruthenium-103	NA	NA	NA	NA	NA	NA	NA	NA	0.019	0.012	0.026	0.011 U
Ruthenium-106	NA	NA	NA	NA	NA	NA	NA	NA	0.04 U	0.04 U	0.05 U	0.04 U
Cesium-134	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cesium-137	0.0201 J	NA	NA	NA	0.00435 U	NA	NA	NA	0.684	0.746	0.671	0.735
Europium-152	-0.0254 U	NA	NA	NA	-0.0112 U	NA	NA	NA	NA	NA	NA	NA
Europium-154	0.0293 U	NA	NA	NA	-0.0283 U	NA	NA	NA	NA	NA	NA	NA
Radium-226	0.469	NA	NA	NA	0.301	NA	NA	NA	NA	NA	NA	NA
Thorium-228	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Thorium-232	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lead-214	NA	NA	NA	NA	NA	NA	NA	NA	0.408	0.428	0.424	0.385
Tin-125	NA	NA	NA	NA	NA	NA	NA	NA	0.115	0.145	0.131	0.194

Concentrations in pCi/g.

Table A1-5. Concentrations Detected in Soil Located Near 1301-N/1325-N. (Page 5 of 8)

Ref. Doc.:														
Location:	RESEARCH WELL #1 (continued)									RESEARCH WELL #2				
Sample ID:														
Collection Date:	Aug-82									Aug-82				
Depth (ft):	25	30	35	40	45	50	55	60	65	5	10	15	20	25
Gross alpha	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Gross beta	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Tritium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Carbon-14	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Uranium-233/234	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Uranium-235	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Uranium-238	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Plutonium - 238	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Plutonium-239/240	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Americium-241	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Strontium-90	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Technetium-99	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Gamma Scan														
Potassium-40	8.21	4.74	10.08	8.16	8.52	8.41	9.57	10.70	13.30	9.75	8.95	7.26	11.41	7.28
Iron-59	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Manganese-54	0.024	0.203	0.019	0.206	0.521	0.383	0.658	0.143	0.043	0.008	0.013 U	0.01	0.006 U	0.004 U
Chromium 51	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cobalt-60	0.906	2.17	0.23	2.17	9.9	9	10.5	6.56	4.38	0.065	0.065	0.07	0.014	0.018
Zinc-65	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ruthenium-103	0.016	0.014 U	0.013 U	0.017 U	0.253	0.163	0.185	0.162	0.191	0.008 U	0.008	0.01 U	0.01 U	0.007 U
Ruthenium-106	0.064	0.063	0.04 U	0.05 U	1.6	1.39	1.47	1.2	1.3	0.04 U	0.04 U	0.06	0.05 U	0.03 U
Cesium-134	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cesium-137	0.548	0.631	0.258	0.772	1.15	0.488	3.96	0.641	0.211	0.014	0.018	0.01	0.015	0.012
Europium-152	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Europium-154	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Radium-226	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Thorium-228	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Thorium-232	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lead-214	0.4	0.375	0.441	0.668	0.376	0.347	0.362	0.389	0.454	0.432	0.448	0.32	0.519	0.303
Tin-125	0.189	0.102	0.013 U	0.057	2.99	2.91	3.13	2.25	1.76	0.013 U	0.013	0.01 U	0.041	0.014 U

Concentrations in pCi/g.

Table A1-5. Concentrations Detected in Soil Located Near 1301-N/1325-N. (Page 6 of 8)

Ref. Doc.:														
Location:	RESEARCH WELL #2 (continued)													
Sample ID:														
Collection Date:	Aug-82													
Depth (ft):	30	35	40	45	50	55	60	65	70	75	80	85	90	95
Gross alpha	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Gross beta	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Tritium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Carbon-14	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Uranium-233/234	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Uranium-235	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Uranium-238	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Plutonium - 238	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Plutonium-239/240	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Americium-241	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Strontium-90	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Technetium-99	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Gamma Scan														
Potassium-40	6.38	6.60	7.53	8.28	8.13		10.30	9.47	9.99	11.60	10.60	8.83	9.07	9.47
Iron-59	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Manganese-54	0.007 U	0.006 U	0.003 U	0.004 U	0.004 U	0.02 U	0.007 U	0.01 U	0.02 U	0.03 U	0.03 U	0.02 U	0.03 U	0.02 U
Chromium 51	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cobalt-60	0.017	0.005	0.004 U	0.025	0.227	0.957	1.22	0.905	0.623	1.48	0.654	0.16	0.185	0.17
Zinc-65	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.05 U	0.04 U	0.04 U	0.03 U	0.06 U
Ruthenium-103	0.01 U	0.008 U	0.006 U	0.007 U	0.008 U	0.04 U	0.024	0.03 U	0.116	0.6	0.2 U	0.2 U	0.2 U	0.2 U
Ruthenium-106	0.06 U	0.03 U	0.03 U	0.03 U	0.04 U	0.23 U	0.157	0.255	0.19 U					
Cesium-134	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cesium-137	0.007 U	0.015	0.01	0.004 U	0.004 U	0.02 U	0.006 U	0.01 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U
Europium-152	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Europium-154	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Radium-226	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Thorium-228	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Thorium-232	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lead-214	0.359	0.324	0.331	0.356	0.322	0.349	0.363	0.331	0.339	0.416	0.384	0.278	0.395	0.37
Tin-125	0.019 U	0.01 U	0.01 U	0.01 U	0.062 U	0.623	0.707	0.647	0.64	0.938	0.519	0.273	0.255	0.19

Concentrations in pCi/g.

Table A1-5. Concentrations Detected in Soil Located Near 1301-N/1325-N. (Page 7 of 8)

Ref. Doc.:														
Location:	RW #2 cont	RESEARCH WELL #3												
Sample ID:														
Collection Date:	Aug-82	Aug-82												
Depth (ft):	100	5	10	15	20	25	30	35	40	45	50	55	60	65
Gross alpha	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Gross beta	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Tritium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Carbon-14	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Uranium-233/234	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Uranium-235	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Uranium-238	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Plutonium - 238	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Plutonium-239/240	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Americium-241	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Strontium-90	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Technetium-99	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Gamma Scan														
Potassium-40	10.80	7.10	7.19	5.91	2.39	5.48	4.83	1.95	5.91	1.24	5.92	2.04	0.72	4.36
Iron-59	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Manganese-54	0.006 U	0.006	0.004 U	0.006 U	0.003 U	0.003 U	0.003 U	0.004 U	0.005 U	0.005 U	0.004 U	0.007 U	0.008 U	0.009 U
Chromium 51	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cobalt-60	0.211	0.054	0.019	0.019	0.006	0.009	0.009	0.008	0.009	0.009	0.2	0.392	0.678	1.55
Zinc-65	0.008 U													
Ruthenium-103	0.078	0.004 U	0.005 U	0.009 U	0.007 U	0.005 U	0.005 U	0.006 U	0.006 U	0.008 U	0.006 U	0.008 U	0.009 U	0.037
Ruthenium-106		0.03 U	0.03 U	0.05 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.04 U	0.04 U	0.04 U	0.278
Cesium-134	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cesium-137	0.0434	0.023	0.017	0.025	0.009	0.003 U	0.009	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U
Europium-152	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Europium-154	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Radium-226	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Thorium-228	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Thorium-232	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lead-214	0.408	0.366	0.361	0.314	0.344	0.326	0.337	0.348	0.338	0.385	0.376	0.323	0.354	0.353
Tin-125	0.142	0.01 U	0.01 U	0.028	0.01 U	0.01 U	0.009 U	0.01 U	0.01 U	0.01 U	0.033 U	0.112	0.372	0.88

Concentrations in pCi/g.

Table A1-5. Concentrations Detected in Soil Located Near 1301-N/1325-N. (Page 8 of 8)

Ref. Doc.:							
Location:	RESEARCH WELL #3 (continued)						
Sample ID:							
Collection Date:	Aug-82						
Depth (ft):	70	75	80	85	90	95	100
Gross alpha	NA	NA	NA	NA	NA	NA	NA
Gross beta	NA	NA	NA	NA	NA	NA	NA
Tritium	NA	NA	NA	NA	NA	NA	NA
Carbon-14	NA	NA	NA	NA	NA	NA	NA
Uranium-233/234	NA	NA	NA	NA	NA	NA	NA
Uranium-235	NA	NA	NA	NA	NA	NA	NA
Uranium-238	NA	NA	NA	NA	NA	NA	NA
Plutonium - 238	NA	NA	NA	NA	NA	NA	NA
Plutonium-239/240	NA	NA	NA	NA	NA	NA	NA
Americium-241	NA	NA	NA	NA	NA	NA	NA
Strontium-90	NA	NA	NA	NA	NA	NA	NA
Technetium-99	NA	NA	NA	NA	NA	NA	NA
Gamma Scan							
Potassium-40	3.55	4.48	1.91	8.42	6.76	6.54	5.95
Iron-59	NA	NA	NA	NA	NA	NA	NA
Manganese-54	0.006 U	0.004 U	0.004 U	0.005 U	0.005 U	0.004 U	0.005 U
Chromium 51	NA	NA	NA	NA	NA	NA	NA
Cobalt-60	1.51	0.366	0.223	0.165	0.141	0.093	0.159
Zinc-65							
Ruthenium-103	0.034	0.025	0.024	0.011 U	0.011 U	0.009 U	0.006 U
Ruthenium-106	0.367	0.097	0.04 U	0.05 U	0.04 U	0.03 U	0.05 U
Cesium-134	NA	NA	NA	NA	NA	NA	NA
Cesium-137	0.005 U	0.004 U	0.004 U	0.005 U	0.004 U	0.004 U	0.004 U
Europium-152	NA	NA	NA	NA	NA	NA	NA
Europium-154	NA	NA	NA	NA	NA	NA	NA
Radium-226	NA	NA	NA	NA	NA	NA	NA
Thorium-228	NA	NA	NA	NA	NA	NA	NA
Thorium-232	NA	NA	NA	NA	NA	NA	NA
Lead-214	0.352	0.381	0.363	0.362	0.384	0.368	0.932
Tin-125	1.12	0.39	0.265	0.119	0.094	0.031	0.037

Concentrations in pCi/g.

R = Concentration should be rejected and not used for decision making purposes due to major quality control problem(s).

ND = Not detected. Reference document did not present detection limits, or detection limits conflicted with other document limits.

NR = Not reported.

NA = Not analyzed.

References:

Summary Data Section, Report Group 7032, 8/6/92 TMA NORCAL, pg11-19

Draft data for Sr-90 from Jane Borghese

Limited Field Investigation Report for the 100-NR-1 Operable Unit (DOE/RL-93-80).

Summary of Maximum Concentrations for Radionuclides, (100-NR-1), p. 1, 2, and 3.

Sediment Chemistry For Wells N-75, N76, N-77, (WHC-SD-EN-DP-056, Rev. 0-A), p B19.

EAL - Gross Radionuclide Soil Screening Sample Analysis Report

Serne - excel file

N-Springs Barrier Wall Drilling Program Data Package, BHI-00135, Rev. 1

Table A1-6. Volatile Organic Compounds Detected in Soil Borings Near 1301-N and 1325-N in 1992.

Location:	199-N-75						199-N-76					
Sample ID:												
Collection Date:	April, 1992	April, 1992	April, 1992	April, 1992	April, 1992	April, 1992	April, 1992	April, 1992	April, 1992	April, 1992	April, 1992	April, 1992
Depth (ft):	2-3	5-6	9	56-58	56-58*	68-70	2-3	5-6	24-25	24-25	55-57	55-57*
Analyte: Units:	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg
Methylene Chloride	4 J	4 J	4	28	11 B	5 J	3 J	8 J	3 J	4 J	55	10 BJ
Acetone	17 J	8 J	22	51 J	49 B	20 J	12 J	ND	31 J	40 J	120 J	55 B
Carbon Disulfide	ND	1 J	ND	2 J	ND	ND	ND	ND	ND	ND	ND	ND
Chloroform	ND	ND	ND	ND	3 BJ	ND	ND	ND	ND	ND	ND	3 BJ
Toluene	2 J	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-Butanone	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Location:	199-N-80						
Sample ID:	B06M60	B06M37	B06M62	B072P4	B072P5	B072P7	B072P9
Collection Date:	July, 1992	July, 1992	July, 1992	July, 1992	July, 1992	July, 1992	July, 1992
Depth (ft):	44-46	50-52	50-52	61-63	70-72	75-77	96-99
Analyte: Units:	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg
Methylene Chloride	6 J	3 J	ND	ND	ND	ND	5 J
Acetone	23 J	13 B	9 J	16	ND	ND	ND
Carbon Disulfide	ND	ND	ND	ND	ND	ND	ND
Chloroform	ND	ND	ND	ND	ND	ND	ND
Toluene	4 J	ND	ND	ND	3 J	7 J	6 J
2-Butanone	ND	ND	ND	ND	ND	ND	8 J

B = The analyte is found in the associated blank, as well as the sample.

J = The associated numerical value is an estimated quantity.

ND = Not detected. Detection limits not reported in this table due to discrepancies found in the reference document.

* = Lab rerun.

Reference: HEIS Data Base, DOE/RL-93-80 Rev. 0.

Table A1-7. Semivolatile Organics Compounds Detected in Soil Near 1301-N/1325-N in 1992.

Location:	Soil from Well199-N-75						Soil from Well 199-N-76							Soil from Well 199-N-80		
Sample ID:	B06837	B06838	B06839	B06843	B06843	B06845	B06835	B06836	B06841	B06841	B06842	B06842	B06844	B06M60	B06M61	B06M37
Date Received:	Apr-92	Apr-92	Apr-92	Apr-92	Apr-92	Apr-92	Apr-92	Apr-92	Apr-92	Apr-92	Apr-92	Apr-92	Apr-92	Jul-92	Jul-92	Jul-92
Depth (ft):	2-3	5-6	9	56-58	56-58 *	68-70	2-3	5-6	24-25	24-25	55-57	55-57*	64.5-66.5	44-46	44-46	50-52
Analyte: Units:	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg
Phenol	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
bis(2-Chloroisopropyl) ether	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Nitrobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Isophorone	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,4-Dimethylphenol	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,4-Dichlorophenol	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Naphthalene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-Methylnaphthalene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dimethylphthalate	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Acenaphthylene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Acenaphthene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dibenzofuran	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Diethylphthalate	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Fluorene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Di-n-butylphthalate	51 J	42 J	ND	76 J	ND	110 J	63 J	56 J	56 J	ND	100 J	ND	99 J	44 J	ND	39 J
Fluoranthene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Pyrene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Butylbenzylphthalte	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzo(a)anthracene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chrysene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
bis(2-Ethylhexyl)phthalate	ND	ND	ND	ND	ND	61 J	ND	ND	530 J	ND	ND	ND	63 J	ND	260 J	ND
Di-n-octylphthalte	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4-Methyl-2-Pentanone	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	7 J	ND	ND	ND
N-Nitrosodiphenylamine	ND	ND	110 J	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Notes:

Analysis Method were not reported.

ND =Not detected. Detection limits are not reported in this table because of discrepancies in reported detection limits.

J = The associated numerical value is an estimated quantity.

B = The analyte is found in the associated blank as well as the sample.

* = Lab rerun

Reference: HEIS Data Base, Original data package dated May 22, 1989 (DOE/RL-93-80 Rev. O)

Table A1-8. Inorganics Compounds Detected in Soil Near 1301-N and 1325-N in 1992.

Location:	199-N-75					199-N-76						199-N-80								
Sample ID:	B06837	B06838	B06839	B06843	B06845	B06835	B06836	B06840	B06841	B06842	B06844	B06M58	B06M60	B06M61	B06M37	B06M62	B072P4	B072P5	B072P7	B072P9
Collection Date:	4/17/92	4/17/92	4/17/92	4/29/92	4/30/92	4/17/92	4/17/92	4/22/92	4/22/92	4/22/92	4/30/92	Jul-92	Jul-92	Jul-92	Jul-92	Jul-92	Jul-92	Jul-92	Jul-92	Jul-92
Depth (ft):	2-3	5-6	9	56-58	68-70	2-3	5-6	24-25	24-25	55-57	64.5-66.5	3.5-5	45-47	45-47	50-52	50-52	57-59	68-70	75-77	95.7-99
Analyte: Units:	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Aluminum	6,720	6,470	5,720	6,300	4,480	6,440	5,750	7,020	7,670	5,740	3,920	ND	3,130 J	ND	ND	ND	ND	ND	ND	3,690 J
Arsenic	3	2	2	2 B	1 B	3	2	4	3	2 B	1 B	ND	ND	ND	ND	2 B	ND	ND	ND	ND
Barium	59	62	61	64	62	52	51	61	70	75	53	ND	ND	ND	ND	ND	ND	ND	29 B	ND
Beryllium	0 B	0 B	0 B	ND	ND	0 B	0 B	0 B	0 B	ND	ND	ND	0 B	ND	ND	ND	ND	ND	ND	ND
Cadmium	0 B	1 B	0 B	ND	ND	0 B	1 B	ND	ND	1 B	1 B	ND	ND	ND	ND	ND	ND	ND	ND	ND
Calcium	6,780	6,380	7,370	2,590	2,240	7,040	5,980	5,670	5,790	2,530	4,480	ND	ND	4,800 J	ND	ND	ND	ND	ND	ND
Chromium	9	9	8	15	8	8	8	10	11	11	9	ND	ND	ND	ND	ND	13 J	ND	ND	ND
Cobalt	10 B	9 B	9 B	6 B	5 B	10 B	9 B	11 B	11	6 B	5 B	ND	11 B	ND	7 B	7 B	5 B	4 B	ND	5 B
Copper	15	15	16	14	9	19	18	26	20	16	10	ND	ND	ND	ND	ND	ND	ND	ND	
Iron	17,400	17,100	18,100	11,000	9,820	18,100	18,500	21,400	21,400	10,800	9,230	ND	ND	6,470 J	ND	ND	ND	ND	ND	9,890 J
Lead	5	4	4	3	2	5	3	8	7	3	3	ND	ND		ND	ND	ND	ND	ND	ND
Magnesium	4,460	4,390	4,400	4,350	2,230	4,460	4,220	5,460	5,410	3,610	2,100	ND	ND	2,040 J	ND	ND	ND	ND	ND	135 J
Manganese	320	296	317	227	162	269	262	328	345	345	208	ND	ND	135 J	ND	ND	ND	ND	ND	0 B
Mercury	ND	ND	ND	ND	ND	ND	0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Nickel	11	10	9	14	8	10	10	12	13	15	9	ND	ND	ND	ND	ND	ND	ND	5 B	ND
Phosphorus	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Potassium	1,350	1,240	1,210	919 B	689 B	1,040	855 B	1,220	1,350	831 B	639 B	ND	ND	ND	655 B	590 B	535 B	976 B	645 B	433 B
Silver	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1 B	ND	ND	ND	ND	ND	ND	1 B
Sodium	204 B	171 B	164 B	203 B	246 B	190 B	172 B	282 B	314	178 B	198 B	ND	227 B	ND	154 B	179 B	104 B	233 B	112 B	149 B
Strontium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Thallium	ND	ND	0 B	ND	ND	0 B	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Vanadium	36	37	34	23	24	34	36	43	45	22	23	42 J	ND	ND	ND	ND	ND	ND	ND	ND
Zinc	41	43	40	29	21	42	40	45	47	34	40	40 J	ND	22 J	ND	ND	ND	ND	ND	ND
Zirconium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Analyses performed by EPA method 6010

ND = Table indicates not detected values at specified detection level. However, the reference indicates the sample was less than the concentration indicated.

J = The associated value is an estimated quantity.

B = The analyte is found in the associated blank as well as the sample.

Reference. HEIS Data Base

WHC-SD-EN-DP-056, Rev. 0-A

SUMMARY OF INVENTORY DATA

Table A1-9. Annual and Cumulative Release to 1301-N and 1325-N LWDF's (Curies).

ANNUAL RELEASES (Curies)

Radionuclide	1964-1966 c	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Cobalt-60	NR	200	82	84	230	330	220	320	320	370	640	870	940	770
Strontium-90	NR	270*	270	7.4	7.3	17	21	16	63	93	110	120	120	130
Ruthenium-106	NR	NR	NR	NR	29	110	63	190	82	110	130	230	330	310
Cesium-134	NR	NR	NR	NR	16	18	4.1	23	39	50	69	83	68	56
Cesium-137	NR	88	41	2.8	51	92	18	46	170	240	320	380	340	290
Plutonium-239/240	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.37	0.55	0.67	1.3	1.1
Totals	NR	560	390	94	330	570	330	600	670	860	1,300	1,700	1,800	1,600

Radionuclide	1980	1981	1982	1983 a	1984 b	1985	1986	1987	1988	1989	1990	1991	1992	1993
Cobalt-60	1200	370	500	770	1500	590	390	200	11	33	7.8	0.0048	7.8	0.0048
Strontium-90	160	84	140	110	310	240	36	15	15	28	14	0.85	14	0.85
Ruthenium-106	320	100	120	65	130	80	49	15	2.8		NA	NA	NA	NA
Cesium-134	55	21	30	14	18	5.7	7.4	2	0.32	0.52	0.12	0.00064	0.12	0.00064
Cesium-137	360	240	270	200	210	88	210	46	8	23	7.1	0.13	7.1	0.13
Plutonium-239/240	1.4	0.56	2.2	2	3.9	3.4	0.24	0.31	0.044	0.023	0.0097	0.00028	0.0097	0.00028
Totals	2,100	820	1,100	1,200	2,200	1,000	700	300	37	85	29	1	29	1

Cumulative Inventory (Curies) d

Radionuclide	1964-1966 c	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Cobalt-60	500	620	620	630	760	980	1,100	1,200	1,400	1,600	2,000	2,500	3,100	3,400
Strontium-90	580	830	1,100	1,100	1,000	1,000	1,000	1,000	1,100	1,100	1,200	1,300	1,400	1,500
Ruthenium-106	100	140	140	140	100	130	110	190	150	160	170	250	360	410
Cesium-134	40	44	48	51	53	54	42	49	68	91	120	160	170	170
Cesium-137	180	260	290	290	330	420	420	460	620	840	1,100	1,500	1,800	2,000
Plutonium-239/240	2.3	3.1	3.9	4.7	5.5	6.2	7.0	7.8	8.6	8.9	9.5	10	11	12
Totals	1,400	1,900	2,200	2,200	2,300	2,600	2,700	2,900	3,400	3,800	4,600	5,700	6,800	7,500

Radionuclide	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
Cobalt-60	4,100	4,000	4,000	4,200	5,100	5,000	4,800	4,400	3,900	3,400	3,000	2,600	2,300	2,000
Strontium-90	1,600	1,700	1,800	1,800	2,100	2,300	2,300	2,200	2,200	2,200	2,100	2,100	2,000	2,000
Ruthenium-106	440	300	240	170	180	nc	nc	nc	nc	nc	nc	nc	nc	nc
Cesium-134	170	140	120	100	87	nc	nc	nc	nc	nc	nc	nc	nc	nc
Cesium-137	2,300	2,500	2,700	2,900	3,000	3,000	3,200	3,100	3,100	3,000	3,000	2,900	2,800	2,800
Plutonium-239/240	14	14	16	18	22	26	27	27	27	27	27	27	27	27
Totals	8,700	8,600	8,800	9,200	11,000	NC	NC	NC	NC	NC	NC	NC	NC	NC

a = 22% of total release to 1325-N LWDF
b = 19% of total release to 1325-N LWDF
c = Extrapolated
d = Inventory = Annual Release
NC = Not Calculated in DQO Workshop.
NR = Not reported
Reference: UNI-3533

Table A1-10. Estimated Amounts of Hazardous Waste Discharged to 1301-N and 1325-N.

Dangerous Waste	Total Pounds per Year, 1301-N	Total Pounds per Year, 1325-N
Acetone (F003)	6,200	6,200
Corrosive (D002)	20,600	20,600
Cadmium (D006)	100	100
Lead (D008)	150	150
Mercury (D009)	6,200	6,200
Hydrazine (U133)	100	100
Carcinogens (WC02)	4,000	4,000
Toxins (WT02)	15,000	15,000
Sodium dichromate (D007)	10,000	None
References: 1301-N LWDF RCRA Permit, Draft Revision 5 1325-N LWDF RCRA Permit, Draft Revision 5		

SUMMARY OF DANGEROUS WASTE OCCURRENCES IN N SPRINGS AREA GROUNDWATER

Table A1-11. Drinking Water Standards Exceed in 100-N Area Wells Data Reporting Period July 1 through September 30, 1994.

Constituents (DWS)	Wells Exceeding DWS (number of samples)
Field conductivity (700 μmho/cm)	1301-N: N-3 (4). N-57 (4)
Lab conductivity (700 μmho/cm)	1301-N: N-3, N-57
Chromium, unfilters samples (50 ppb)	1301-N: N-57, N-67 1325-N: N-4, N-81
Iron, unfiltered samples (300 ppb)	1301-N: N-57, N-67 1325-N: N-32, N-41, N-74, N-81
Manganese, unfiltered samples	1301-N: N-57 1325-N: N-81
Nitrate (45,000 ppb)	1301-N: N-3
Strontium-90 (8 pCi/L)	1301-N: N-2, N-34, N-57 (2), N-67, N-75 1325-N: N-27, N-29, N-81
Tritium (20,000 pCi/L)	1301-N: N-2, N-34, N-67, N-69, N-75 1325-N: N-27, N-29, N-32, N-41, N-70, N-81

DWS = drinking water standard
Modified from DOE/RL-94-36-3

SUMMARY OF RLS DATA

Table A1-12. Spectral Gamma Logging and Field Screening Results for Wells Near 1301-N/1325-N. (Page 1 of 6)

	Well #1 1982									Well #2 1982						Well #3 1982						N-27 1984		N-28 1984		N-25 1980
Depth (ft)	Manganese-54	Cobalt-60	Cesium-137	Potassium-40	Cobalt-60	Ruthenium-103	Cesium-137	Iodine-131	Antimony-125	Potassium-40	Cobalt-60	Ruthenium-103	Cesium-137	Iodine-131	Antimony-125	Potassium-40	Cobalt-60	Ruthenium-103	Cesium-137	Iodine-131	Antimony-125	Gross Gamma	Cobalt-60	Gross Gamma	Cobalt-60	Gross Gamma
0																						310	1.1	978	0.3	
5	0.78	3.54	6.64	11.7	0.45		0.08	0.07	0.13													57		55		80
10	0.87	12.2	12.3	12.3	0.09		0.12			10.3	0.05											55		52		80
15	1.07	1.71	11	11.4	3.68		2.46			10.1	0.03					11						51		54		80
20	49.8	169	323	12.8	1.53		1.4		0.26	9.89	0.05					11.2	0.02	0.07		0.05		62		67		80
25	182	273	1836	10	0.61		1.02	0.04		9.44	0.01					10.7	0.01					69		67		80
30				11.1	0.15					10.1	0.03				0.19	11.6						65		65		80
35				12	0.11					11.1	0.02											124	1.1	67		80
40				13.6	11				0.07	11.5	0.03					12.1					0.15	126	0.8	64		80
45				12.4	10.5			0.69	1.97	11.1	0.03	0.04				13.2						173	2.5	64		80
50				11.8	7.7			0.72	1	11.5	0.71				0.27	12.5	0.38	0.03				1138	58.8	83		80
55				11.5	7.28	0.27		7.61	1.56	14.2	0.93	0.19		1.26	1.1	13.2	0.68		0.05			368	15.4	101		325
60																13.6	1.44	0.08		0.96	0.99	262	6.1	95	0.2	325
65																15	2.34			1.24	1.39	268	7.3	182	3.7	325
70																12.1	1.64			2.94	1.35			161	2.4	200
75																								102	0.9	200
80																								116	1.5	160
85																										150
90																										130
95																										
100																										
105																										
110																										
115																										
120																										

Gross count rate in counts per second. All other concentrations are in pCi/g

A blank is used to denote no isotope identified by spectroscopic system, (i.e. below detection threshold if present).

Measurements are reported every 5 feet in this table, even though logs are taken continuously.

Table A1-12. Spectral Gamma Logging and Field Screening Results for Wells Near 1301-N/1325-N. (Page 2 of 6)

Depth (ft)	N-29 1984					N-30 1984	N-31 1984	N-32 1984	N-33 1984	N-34 1984	N-35 1984	N-36 1984	N-39 1984				N-40 1984	N-41 1984	N-42 1984	N-44 1984				N-45 1984
	Gross Gamma	Cobalt-60	Potassium-40	Uranium	Thorium	Gross Gamma	Gross Gamma	Gross Gamma	Gross Gamma	Gross Gamma	Gross Gamma	Gross Gamma	Gross Gamma	Cobalt-60	Potassium-40	Uranium	Thorium	Gross Gamma	Gross Gamma	Gross Gamma	Cobalt-60	Potassium-40	Uranium	Thorium	Gross Gamma
0	1025		6.2	0.9									171		10	0.7	0.6				180		8.8	0.8	0.9	
5	54		3.1	0.7	0.3	50	50	45	25	50	90	60	105		17.6	1.1	1.4	60	55	65	103		15.6	0.8	1.1	75
10	57		8.2	0.6	1	50	50	40	25	60	75	50	84		11.3	0.6	1	60	50	60	78		13.3	0.9	0.9	50
15	50		2.7	0.6	0.6	50	50	40	25	50	75	60	71		12.2	0.8	0.9	60	55	60	75		11.2	0.7	1	50
20	46		5.1	0.4	0.7	50	50	50	25	50	75	50	72		11.7	0.7	0.3	60	55	50	69		7.5	0.6	0.7	50
25	69		9.8	0.6	0.6	50	60	55	25	50	100	50	81		11.4	0.4	1.5	60	60	60	70		9.5	0.7	0.7	50
30	64		11.1	0.8	0.7	50	60	50	25	50	250	55	82		17	0.6	0.6	30	60	65	68		9.6	0.5	0.7	50
35	67	0.1	9.4	0.7	0.8	50	60	50	25	50	175	55	78		9.4	0.9	0.7	65	60	70	70		9.8		0.6	60
40	69		9.1	0.8	1.1	50	60	50	25	50	500	70	100		11.5	0.7	0.4	75	65	75	94		14.3	0.4	0.5	75
45	79		11.8	1.4	0.4	60	60	55	50	60	4000	60	81		11.5	0.3	0.4	75	65	75	92		12.1	0.4	0.7	90
50	92	0.1	8.3	0.5	0.5	75	75	70	50	60	2500	55	113	0.2	14.4	1.1	0.9	65	70	70	109		18.2	1.1	1.4	150
55	109	0.1	11	0.5	0.7	90	75	90	60	60	2100	45	108	0.1	15.9	1.2	0.7	65	65	75	113	1.3	13.5	0.5	0.4	125
60	151	0.9	9.1	0.8	0.8	100	75	100	60	75	2500	55	132	0.3	18	1.2	0.9	70	60	80	127	0.8	16.8	0.6	0.7	110
65	430	9	13.8	0.9	0.5	100	75	85	75	80	2500	70						55	55	65	181	4	19.3	0.8	0.7	800
70	175	1.3	12.9	0.8	0.5	140	100	60	75	100		55						55	50	55						800
75	129	1	16	0.9	0.7	150	125	55		125		50						55	50	50						
80	147	1.6	12.3	1.1	0.5	200	100	60		100		60							50							
85																										
90																										
95																										
100																										
105																										
110																										
115																										
120																										

Gross count rate in counts per second. All other concentrations are in pCi/g
A blank is used to denote no isotope identified by spectroscopic system, (i.e. below detection threshold if present).
Measurements are reported every 5 feet in this table, even though logs are taken continuously.

Table A1-12. Spectral Gamma Logging and Field Screening Results for Wells Near 1301-N/1325-N. (Page 3 of 6)

Depth (ft)	N-67 1988	N-69 1988	N-70 1984						N-75 1984						N-76 1984						N-80 1984		N-90 1984					
	Gross Gamma	Gross Gamma	Gross Gamma	Cobalt-60	Potassium-40	Uranium	Thorium		Gross Gamma	Cesium-137	Cobalt-60	Potassium-40	Uranium	Thorium	Gross Gamma	Cobalt-60	Potassium-40	Uranium	Thorium		Gross Gamma	Cobalt-60	Gross Gamma	Cesium-137	Cobalt-60	Potassium-40	Uranium	Thorium
0			173		17.5	0.7	1.1		177			5.1			119		8.7	0.3	0.6		187		654	0.9	19.8	2	0	0
5	40	50	84		7.9	0.7	0.5		42			7.6	1.1		57		6.1	0.7			47		53			6.3	1.2	1.3
10	40	50	59		4.5	1.2	0.5		47			5.3	0.4	0.4	178		10.6	2.2	2.8		46		51			8	0.7	0.7
15		50	66		5.2	0.7	0.4		46			5.5	0.2	0.2	178		7.1	2.6	3		43		51			7.9	1	0.3
20	125	50	177		4.8	2.9	2.5		62			10.5	0.5	0.6	183		8.9	2.4	4.3		67							
25		50	150		9.4	1.6	2.3		65			8	0.4	1.1	167		7.8	2.5	2		67							
30	40	50	158		9	1.5	2.3		62			10.7	0.5	0.6	171		10.1	2.8	2.8		69							
35		55	156		9.3	2.3	1.7		61			10.2	0.6	0.9	174	0.1	10.8	2.8	2.4		74							
40	1000	60	195		8.3	2.2	3.2		69			11.4	0.8	0.6	168		13.2	2.7	3.1		76							
45		75	187		11.1	2.9	2.8		71			12.1	0.8	0.7	169		11.9	1.9	1.7		81							
50	800	110	178		9.9	1.9	4.5		72			11.1	0.4	0.9	182		13.6	2.5	3		91	0.2						
55		250	143		11.6	1.5	2.9		88		0.2	11.6	0.7	0.6	162	0.5	21.1	1.1	0.7		105	0.4						
60	200	225	121	0.3	16.6	1	1.3		126		0.2	13.4	0.9	0.7	128	0.2	18.4	1	0.7		97	0.3						
65		200	100		19.9	0.7	1.3		124		0.3	11.1		0.9	96		18.5		0.5		125	0.6						
70	125	180	87	0.1	8.8	0.4	1.5		61		0.2	8.2		0.5	93	0.1	16.2	0.4	1.1		94							
75	125	75	112	0.1	7.4	1.5	2.3		62			6.5	1		90		17	0.2	0.3		84							
80		75	113		12.1	2.3	2		58			9.6	0.8	1							73							
85		75	80	0.3	14.6	1.4			53		0.4	12.1	0.5	0.5							75							
90		75	94	1.3	12.7	0.7	0.8														79							
95		95	78	0.1	16.1	0.3	0.7														79							
100																					102		102					
105																					120		120					
110																					109		109					
115																					88		88					
120																					125		125					

Gross count rate in counts per second. All other concentrations are in pCi/g

A blank is used to denote no isotope identified by spectroscopic system, (i.e. below detection threshold if present).

Measurements are reported every 5 feet in this table, even though logs are taken continuously.

Table A1-12. Spectral Gamma Logging and Field Screening Results for Wells Near 1301-N/1325-N. (Page 4 of 6)

Depth (ft)	199-N-91A 1994										199-N-92A 1994										199-N-93A 1994									
	Potassium-40	Cobalt-60	Ruthenium-106	Radium-226	Thorium-232	Uranium-235	Strontium-90	Potassium-40	Cobalt-60	Ruthenium-106	Antimony-125	Cesium-137	Radium-226	Thorium-232	Uranium-235	Strontium-90	Potassium-40	Cobalt-60	Antimony-125	Cesium-137	Radium-226	Thorium-232	Uranium-235	Tritium	Strontium-90
0																										
5																										
10	23.84	0.12		0.74	0.84		1.16											23.24	0.39	0.36		0.83	0.92		0.29	2.17
15	22.85	0.26	1.81	0.73	0.77		0.81	32.82	0.37		0.77	0.09	1.06	1.34	2.63	0.62		22.11	1.20	1.54		1.58	2.06	2.90	4.77	22.00
20	21.45	0.15		0.83	1.02		0.61	28.63	0.13				0.63	0.74		1.01		26.37	0.43	0.48		0.84	1.02		8.56	6.90
25																										
30																										
35																										
40																		32.10		1.14		1.63	2.52	5.76	3.86	0.91
45	28.79			1.50	2.02	2.84	0.84	12.17		4.04			0.66	1.71		0.81										
50																										
55																										
60																										
65																										
70																										
75																										
80																										
85																										
90																										
95																										
100																										
105																										
110																										
115																										
120																										

Gross count rate in counts per second. All other concentrations are in pCi/g

A blank is used to denote no isotope identified by spectroscopic system, (i.e. below detection threshold if present).

Measurements are reported every 5 feet in this table, even though logs are taken continuously.

Table A1-12. Spectral Gamma Logging and Field Screening Results for Wells Near 1301-N/1325-N. (Page 5 of 6)

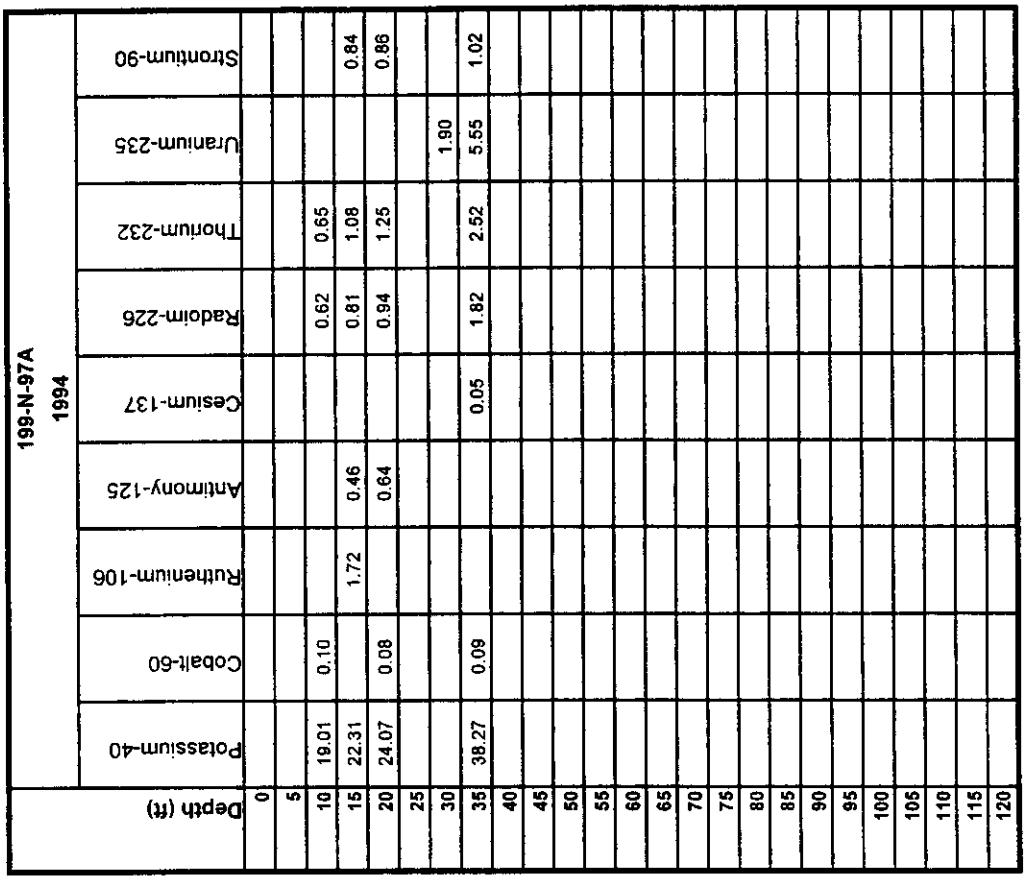
	199-N-94A 1994									199-N-95A 1994									199-N-96A 1994								
Depth (ft)	Potassium-40	Cobalt-60	Cadium-109	Antimony-125	Radium-226	Thorium-232	Uranium-235	Tritium	Strontium-90	Potassium-40	Cobalt-60	Antimony-125	Radium-226	Thorium-232	Tritium	Strontium-90	Potassium-40	Cobalt-60	Antimony-125	Radium-226	Thorium-232	Uranium-235	Tritium	Strontium-90
0																								
5	20.36	1.00		0.31	0.76	0.81		0.32	36.20	21.76	0.21		0.67	0.76	0.20	1.28								
10	25.34	0.50		0.20	0.86	1.07		1.71	51.00	22.57	1.29		0.65	0.73	0.05	37.80	22.65			0.71	0.70		0.05	0.56
15	23.03	0.30		0.54	0.86	1.00		3.60	15.70	19.69	0.39	0.40	0.79	1.23	2.88	2.76	19.47		0.19	0.90	0.84	2.22	0.03	0.60
20										18.45	0.22	0.39	0.63	0.72	2.30	14.00	26.83	0.05		1.00	1.03		0.19	0.82
25	24.57	0.38	3.95		1.02	1.14		7.34	9.86	19.49	0.19		0.62	0.75	0.95	10.50	21.19	0.43		0.84	1.05	3.69	0.14	1.14
30	23.23	0.21			0.89	1.06		6.58	5.10															
35										19.01		0.62	0.78	1.16	11.80	1.22								
40																								
45	28.22			1.04	1.64	2.29	0.28	0.45	2.04								23.14	0.16		0.97	1.33		0.80	0.70
50																								
55																								
60																								
65																								
70																								
75																								
80																								
85																								
90																								
95																								
100																								
105																								
110																								
115																								
120																								

Gross count rate in counts per second. All other concentrations are in pCi/g

A blank is used to denote no isotope identified by spectroscopic system, (i.e. below detection threshold if present).

Measurements are reported every 5 feet in this table, even though logs are taken continuously.

Table A1-12. Spectral Gamma Logging and Field Screening Results for Wells Near 1301-N/1325-N. (Page 6 of 6)



199-N-97A
1994

Depth (ft)	Potassium-40	Cobalt-60	Ruthenium-106	Antimony-125	Cesium-137	Radium-226	Thorium-232	Uranium-235	Strontium-90
0									
5									
10	19.01	0.10				0.62	0.65		0.84
15	22.31		1.72	0.46		0.81	1.08		0.86
20	24.07	0.08		0.64		0.94	1.25		
25								1.90	
30								5.55	1.02
35	38.27	0.09			0.05	1.82	2.52		
40									
45									
50									
55									
60									
65									
70									
75									
80									
85									
90									
95									
100									
105									
110									
115									
120									

Gross count rate in counts per second. All other concentrations are in pCi/g

A blank is used to denote no isotope identified by spectroscopic system, (i.e. below detection threshold if present).

Measurements are reported every 5 feet in this table, even though logs are taken continuously.

BACKUP FOR GRAPHICAL SUMMARIES

Table A1-13. Summary of Calculation for Average Concentrations in 1301-N Trench Sediment in May 30, 1995.

Location	Collection Date	Original Data (pCi/g)				Decayed to May 30, 1995 (pCi/g)				Average- 1995 (pCi/g)			
		Cobalt 60	Cesium 137	Strontium 90	Plutonium 239/240	Cobalt 60	Cesium 137	Strontium 90	Plutonium 239/240	Cobalt 60	Cesium 137	Strontium 90	Plutonium 239/240
TS-01	1/1/80	13,000,000	270,000	NA	NA	1,700,000	190,000	120,000	28,000				
	1/1/81	8,600,000	190,000	170,000	28,000	990,000	140,000	80,000	28,000				
	1/1/82	21,000,000	940,000	110,000	28,000	3,600,000	690,000	80,000	28,000				
	1/1/83	22,000,000	83,000,000	46,000	12,000	4,300,000	63,000,000	34,000	12,000				
	8/1/84	53,000,000	3,100,000	NA	NA	13,000,000	2,400,000						
	8/1/85	1,300,000	29,000	93,000	26,000	360,000	23,000	74,000	26,000	4,000,000	11,000,000	77,000	23,000
TS-02	1/1/80	8,800,000	210,000	NA	NA	1,200,000	150,000						
	1/1/81	6,300,000	190,000	770,000	9,200	950,000	140,000	550,000	9,200				
	1/1/82	27,000,000	490,000	250,000	63,000	4,600,000	360,000	180,000	63,000				
	1/1/83	16,000,000	550,000	46,000	13,000	3,100,000	420,000	34,000	13,000				
	8/1/84	22,000,000	960,000	NA	NA	5,300,000	750,000						
	8/1/85	1,100,000	26,000	77,000	16,000	300,000	21,000	61,000	16,000	2,600,000	310,000	210,000	25,000
TS-03	1/1/80	8,400,000	120,000	NA	NA	1,100,000	85,000						
	1/1/81	19,000,000	530,000	110,000	25,000	2,600,000	380,000	78,000	25,000				
	1/1/82	34,000,000	940,000	320,000	170,000	5,800,000	690,000	230,000	170,000				
	1/1/83	25,000,000	580,000	29,000	10,000	4,800,000	440,000	22,000	10,000				
	8/1/84	32,000,000	820,000	NA	NA	7,700,000	640,000						
	8/1/85	1,600,000	37,000	210,000	27,000	440,000	30,000	170,000	27,000	3,800,000	380,000	130,000	58,000
TS-04	1/1/80	5,100,000	220,000	NA	NA	670,000	160,000						
	1/1/81	6,000,000	330,000	36,000	12,000	900,000	240,000	26,000	12,000				
	1/1/82	6,400,000	530,000	150,000	2,800,000	1,100,000	390,000	110,000	2,800,000				
	1/1/83	8,000,000	380,000	26,000	7,500	1,600,000	280,000	19,000	7,500				
	8/1/84	16,000,000	750,000	NA	NA	3,900,000	590,000						
	8/1/85	1,200,000	28,000	110,000	23,000	330,000	22,000	87,000	23,000	1,400,000	280,000	61,000	710,000
TS-05	1/1/80	3,100,000	260,000	NA	NA	410,000	180,000						
	1/1/81	4,400,000	490,000	21,000	5,500	660,000	350,000	15,000	5,500				
	1/1/82	6,600,000	540,000	110,000	660,000	1,100,000	400,000	80,000	660,000				
	1/1/83	5,200,000	720,000	13,000	3,000	1,000,000	540,000	9,700	3,000				
	8/1/84	8,300,000	1,300,000	NA	NA	2,000,000	1,000,000						
	8/1/85	950,000	55,000	190,000	21,000	260,000	44,000	150,000	21,000	910,000	420,000	64,000	170,000
TS-06	1/1/80	5,600,000	210,000	NA	NA	740,000	150,000						
	1/1/81	17,000,000	570,000	96,000	25,000	2,600,000	410,000	68,000	25,000				
	1/1/82	15,000,000	500,000	230,000	44,000	2,600,000	370,000	170,000	44,000				
	1/1/83	16,000,000	950,000	46,000	9,800	3,100,000	720,000	34,000	9,800				
	8/1/84	23,000,000	750,000	NA	NA	5,500,000	590,000						
	8/1/85	1,100,000	68,000	120,000	24,000	300,000	54,000	95,000	24,000	2,500,000	380,000	92,000	26,000
TS-07	1/1/80	1,700,000	240,000	NA	NA	220,000	170,000						
	1/1/81	8,900,000	530,000	110,000	30,000	1,300,000	380,000	78,000	30,000				
	1/1/82	14,000,000	1,000,000	83,000	17,000	2,400,000	740,000	60,000	17,000				
	1/1/83	6,000,000	800,000	27,000	6,200	1,200,000	600,000	20,000	6,200				
	8/1/84	16,000,000	980,000	NA	NA	3,900,000	770,000						
	8/1/85	1,300,000	56,000	120,000	14,000	360,000	45,000	95,000	14,000	1,600,000	450,000	63,000	17,000
TS-08	1/1/80	7,600,000	630,000	NA	NA	1,000,000	440,000						
	1/1/81	5,400,000	440,000	25,000	6,600	810,000	320,000	18,000	6,600				
	1/1/82	4,500,000	460,000	70,000	16,000	770,000	340,000	51,000	16,000				
	1/1/83	4,000,000	400,000	13,000	4,600	780,000	300,000	9,700	4,600				
	8/1/84	16,000,000	730,000	NA	NA	3,900,000	570,000						
	8/1/85	260,000	22,000	70,000	11,000	71,000	18,000	55,000	11,000	1,200,000	330,000	33,000	9,600
TS-09	1/1/80	4,300,000	350,000	NA	NA	570,000	250,000						
	1/1/81	8,300,000	780,000	45,000	20,000	1,200,000	560,000	32,000	20,000				
	1/1/82	4,300,000	560,000	150,000	13,000	740,000	410,000	110,000	13,000				
	1/1/83	4,000,000	390,000	6,700	4,300	780,000	290,000	6,500	4,300				
	8/1/84	15,000,000	1,300,000	NA	NA	3,600,000	1,000,000						
	8/1/85	840,000	25,000	110,000	20,000	180,000	20,000	87,000	20,000	1,200,000	430,000	59,000	14,000

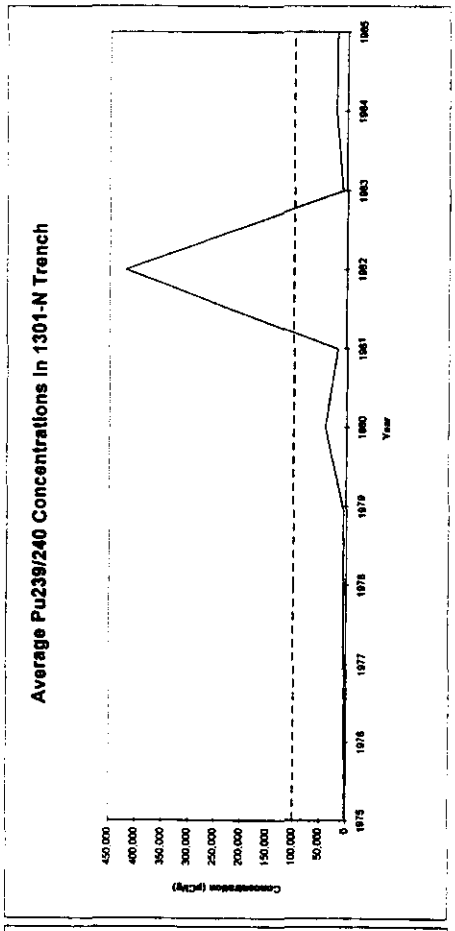
NA = Not analyzed

Table A1-14. Summary of Calculation for Average Concentrations in 1325-N Crib Sediment in May 30, 1995.

Location	Collection Date	Original Data (pCi/g)				Decayed to May 30, 1995 (pCi/g)				Average - 1995 (pCi/g)			
		Cobalt 60	Cesium 137	Strontium 90	Plutonium 239/240	Cobalt 60	Cesium 137	Strontium 90	Plutonium 239/240	Cobalt 60	Cesium 137	Strontium 90	Plutonium 239/240
CS-01	8/1/85	1,300,000	41,000	88,000	12,000	380,000	33,000	70,000	12,000				
	6/24/86	9,100,000	180,000	9,100	NA	2,800,000	150,000	7,400	NA				
	7/8/87	820,000	32,000	14,000	5,200	290,000	27,000	12,000	5,200				
										1,200,000	69,000	30,000	8,600
CS-02	8/1/85	660,000	49,000	26,000	5,000	180,000	39,000	21,000	5,000				
	6/24/86	520,000	62,000	3,900	NA	160,000	50,000	3,200	NA				
	7/8/87	1,400,000	ND	40,000	49,000	500,000	ND	33,000	49,000				
										280,000	45,000	19,000	27,000
CS-03	8/1/85	1,100,000	49,000	89,000	13,000	300,000	39,000	70,000	13,000				
	6/24/86	2,300,000	88,000	5,000	NA	710,000	72,000	4,000	NA				
	7/8/87	630,000	18,000	5,900	1,600	220,000	15,000	4,900	1,600				
										410,000	42,000	26,000	7,300
CS-04	8/1/85	600,000	35,000	27,000	4,300	160,000	28,000	21,000	4,300				
	6/24/86	2,500,000	85,000	5,000	NA	770,000	69,000	4,000	NA				
	7/8/87	630,000	29,000	4,300	9,900	220,000	24,000	3,600	9,900				
										380,000	40,000	9,500	7,100
CS-05	8/1/85	180,000	13,000	15,000	2,800	49,000	10,000	12,000	2,800				
	6/24/86	620,000	92,000	3,400	NA	190,000	75,000	2,700	NA				
	7/8/87	680,000	30,000	10,000	8,500	240,000	25,000	8,300	8,500				
										160,000	37,000	7,700	5,700
CS-07	8/1/85	1,600,000	11,000	200,000	30,000	440,000	8,800	160,000	30,000				
	6/24/86		ND		NA		ND		NA				
	7/8/87	1,300,000	48,000	630,000	98,000	460,000	40,000	520,000	98,000				
										450,000	24,000	340,000	64,000
CS-08	8/1/85	1,700,000	29,000	100,000	56,000	470,000	23,000	79,000	56,000				
	6/24/86	1,700,000	66,000		NA	530,000	54,000		NA				
	7/8/87	1,100,000	15,000	270,000	120,000	390,000	13,000	220,000	120,000				
										460,000	18,000	150,000	88,000
CS-09	8/1/85	140,000	5,000	17,000	12,000	38,000	4,000	13,000	12,000				
	6/24/86	2,800,000	80,000	9,200	NA	870,000	65,000	7,400	NA				
	7/8/87	820,000	17,000	10,000	8,300	290,000	14,000	8,300	8,300				
										400,000	28,000	9,600	10,000
CS-10	8/1/85	520,000	56,000	13,000	2,300	140,000	45,000	10,000	2,300				
	7/8/87	140,000	21,000	14,000	1,400	50,000	18,000	12,000	1,400				
										95,000	31,000	11,000	1,900
CS-11	8/1/85	800,000	48,000	12,000	6,900	220,000	38,000	9,500	6,900				
	7/8/87	840,000	13,000	29,000	20,000	300,000	11,000	24,000	20,000				
										260,000	25,000	17,000	13,000
CS-12	8/1/85	580,000	71,000	5,800	34,000	160,000	57,000	4,600	34,000				
	7/8/87	1,200,000	13,000	35,000	39,000	420,000	11,000	29,000	39,000				
										290,000	34,000	17,000	37,000

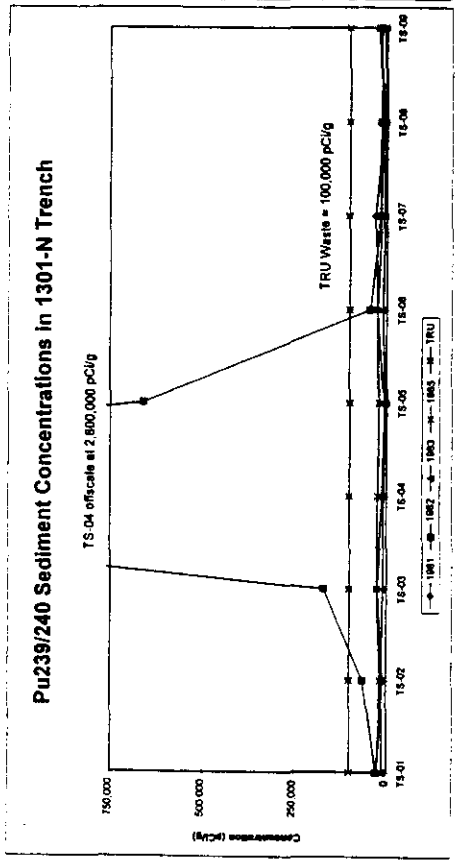
NA = Not analyzed. ND= Undetected at specified detection limit.

Table A1-15. Plutonium-239/240 in 1301-N Trench.



Pu239/240 Concentrations (pCi/g) 1301-N Trench

	1981	1982	1983	1985	TRU
TS-01	26,000	28,000	12,000	26,000	100,000
TS-02	9,200	63,000	13,000	16,000	100,000
TS-03	25,000	170,000	10,000	27,000	100,000
TS-04	12,000	2,800,000	7,500	23,000	100,000
TS-05	5,500	660,000	3,000	21,000	100,000
TS-06	25,000	44,000	9,800	24,000	100,000
TS-07	30,000	17,000	6,200	14,000	100,000
TS-08	6,600	16,000	4,600	11,000	100,000
TS-09	20,000	13,000	4,300	20,000	100,000



Average Concentration (pCi/g)

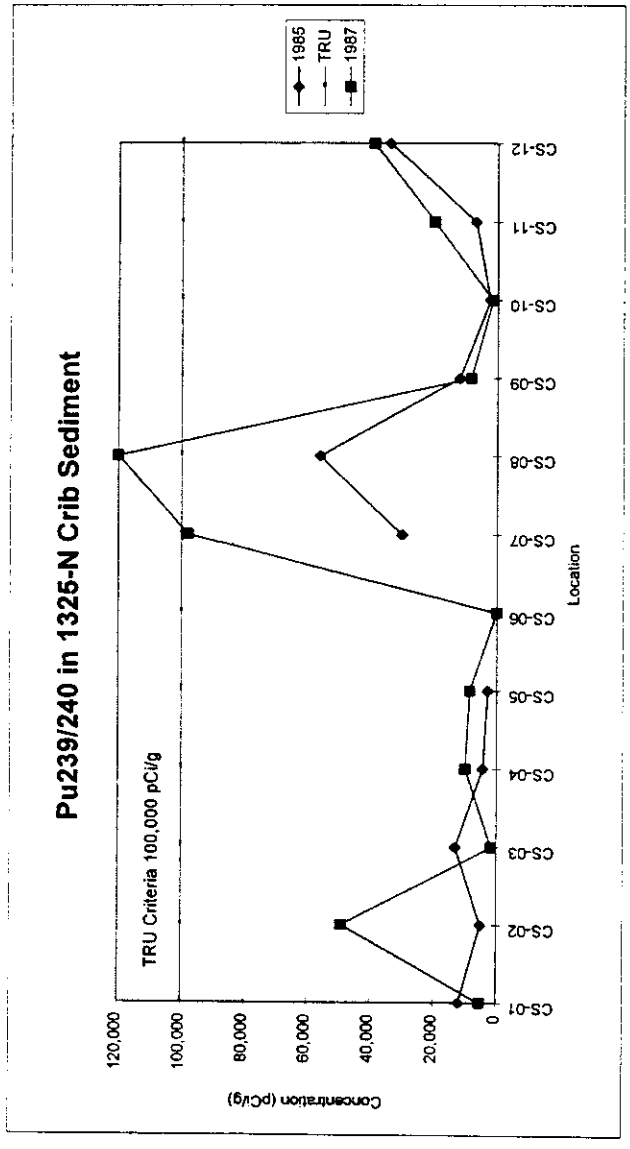
Year	Average	TRU
1975	980	100,000
1976	3,700	100,000
1977	4,600	100,000
1978	5,200	100,000
1979	6,200	100,000
1980	40,000	100,000
1981	18,000	100,000
1982	420,000	100,000
1983	7,800	100,000
1984	21,000	100,000
1985	20,000	100,000

Table A1-16. Plutonium-239/240 in 1325-N Trench.

Pu239/240 Concentrations (pCi/g)

	1985	1987	TRU
CS-01	12,000	5,200	100,000
CS-02	5,000	49,000	100,000
CS-03	13,000	1,600	100,000
CS-04	4,300	9,900	100,000
CS-05	2,800	8,500	100,000
CS-06			100,000
CS-07	30,000	98,000	100,000
CS-08	56,000	120,000	100,000
CS-09	12,000	8,300	100,000
CS-10	2,300	1,400	100,000
CS-11	6,900	20,000	100,000
CS-12	34,000	39,000	100,000

YEAR	AVERAGE	TRU
1985	13,000	100,000
1986		100,000
1987	33,000	100,000
1988	14,000	100,000



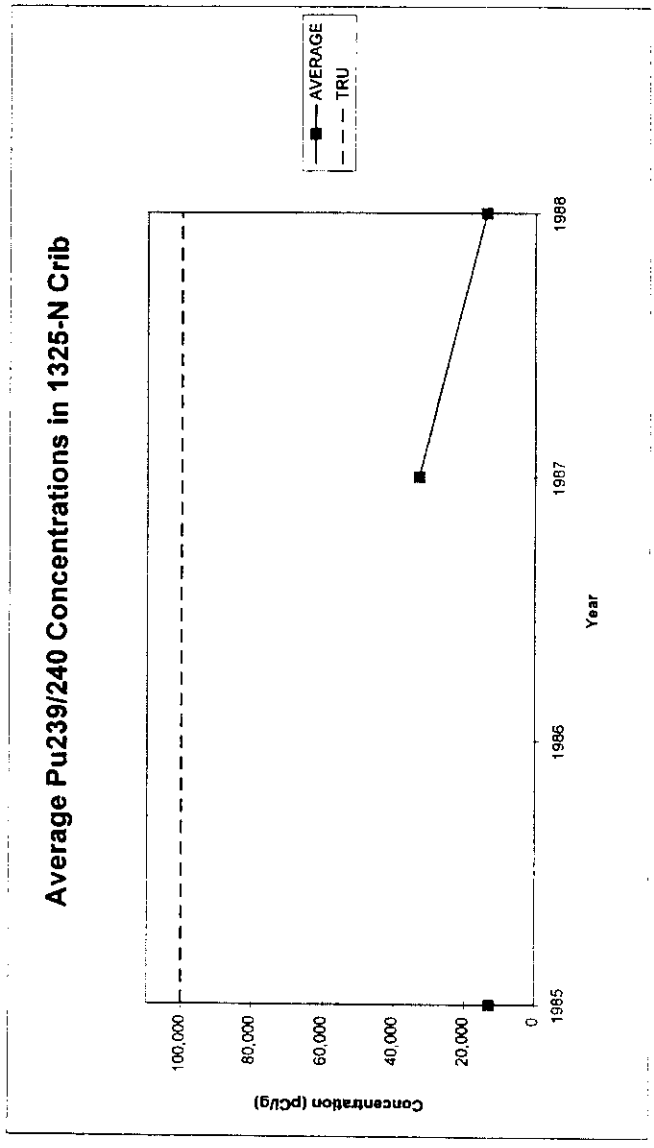


Table A1-17. Summary of Soil Data for Cross Section A - A'.

	Cobalt-60								Cesium-137							
	Original Concentration (pCi/g)				Decayed to 5/30/95 (pCi/g)				Original Concentration (pCi/g)				Decayed to 5/30/95 (pCi/g)			
Depth (ft)	N-94A	N-76	N-75	N-105A	N-94A	N-76	N-75	N-105A	N-94A	N-76	N-75	N-105A	N-94A	N-76	N-75	N-105A
Date	10/1/94	4/1/92	4/1/92	4/1/95					10/1/94	4/1/92	4/1/92	4/1/95				
2		ND	ND			ND	ND			ND	ND			ND	ND	
5	1.00	ND	ND		0.91	ND	ND		ND	ND	ND	ND	ND	ND	ND	ND
10	0.50		ND	ND	0.46		ND	ND	ND		ND	ND	ND		ND	ND
15	0.30			ND	0.28			ND	ND			ND	ND			ND
20				ND				ND				ND				ND
25	0.38	ND		ND	0.35	ND		ND	ND	ND		ND	ND	ND		ND
30	0.21			ND	0.19			ND	ND			ND	ND			ND
35				ND				ND				ND				ND
40				ND				ND				ND				ND
45	ND			ND	ND			ND	ND			ND	ND			ND
50				0.12				0.12				ND				ND
55		2.00	0.52	0.70		1.32	0.34	0.69		ND	ND	ND		ND	ND	ND
60				0.67				0.66				ND				ND
65		0.18		0.17		0.12		0.17		ND		ND		ND		ND
70			0.28	0.15			0.18	0.15			ND	ND			ND	ND
75				0.10				0.09				ND				ND
80				ND				ND				ND				ND
85				ND				ND				ND				ND
90				ND				ND				ND				ND
95				ND				ND				ND				ND
100																

	Strontium-90								Plutonium-239/240			
	Original Concentration (pCi/g)				Decayed to 5/30/95 (pCi/g)				Original (pCi/g)		5/30/95 (pCi/g)	
Depth (ft)	N-94A	N-76	N-75	N-105A	N-94A	N-76	N-75	N-105A	N-94A	N-76	N-75	N-105A
Date	10/1/94	4/1/92	4/1/92	4/1/95		4/1/92	4/1/92	4/1/95	4/1/92	4/1/92	4/1/92	4/1/92
2		1.00	ND			0.93	ND		ND	ND	ND	ND
5	36.20	ND	ND		35.64	ND	ND		ND	ND	ND	ND
10	51.00		ND	1.50	50.20		ND	1.39		ND		ND
15	15.70			0.87	15.46			0.81				
20				0.64				0.59				
25	9.90	ND		0.34	9.75	ND		0.32	ND		ND	
30	5.10			1.10	5.02			1.02				
35				1.80				1.67				
40				3.10				2.88				
45	2.00			3.10	1.97			2.88				
50				431.40				400.12				
55		320.00	190.00	135.55		296.80	176.23	125.73	ND	ND	ND	ND
60				149.34				138.51				
65		2.00		90.79		1.86		84.21	ND		ND	
70			120.00	101.29			111.30	93.94		ND		ND
75				70.24				65.15				
80				11.50				10.67				
85				1.66				1.54				
90				2.91				2.70				
95				0.76				0.71				

ND - Not detected. Well number begins with 199-; 199-N-94A

Table A1-18. Summary of Soil Data for Cross Section B - B'.

	Original Concentration (pCi/g)						Concentration Decayed to 5/30/95 (pCi/g)					
Depth (ft)	N-95A	N-80	N-103A	Well#3	Well#2	Well#1	N-95A	N-80	N-103A	Well#3	Well#2	Well#1
Date	9/1/94	7/1/92	4/1/92	8/1/82	8/1/82	8/1/82						
Cobalt-60												
5	0.21	ND		0.05	0.07	0.60	0.19	ND		0.01	0.01	0.11
10	1.29			0.02	0.07	0.75	1.17			4E-03	0.01	0.14
15	0.39			0.02	0.07	0.78	0.35			4E-03	0.01	0.14
20	0.22			0.01	0.01	0.84	0.20			1E-03	3E-03	0.15
25	0.19			0.01	0.02	0.91	0.18			2E-03	3E-03	0.17
30	ND		ND	0.01	0.02	2.17	ND		ND	2E-03	3E-03	0.40
35	ND			0.01	0.01	0.23	ND			1E-03	9E-04	0.04
40	ND			0.01	ND	2.17	ND			2E-03	ND	0.40
45	ND	ND		0.01	0.03	9.90	ND	ND		2E-03	5E-03	1.83
50		ND		0.20	0.23	9.00		ND		0.04	0.04	1.67
55			ND	0.39	0.96	10.50			ND	0.07	0.18	1.94
60		0.41	ND	0.68	1.22	6.56		0.28	ND	0.13	0.23	1.21
65			ND	1.55	0.91	4.38			ND	0.29	0.17	0.81
70		0.23	1.20	1.51	0.62			0.16	0.79	0.28	0.12	
75		0.13	0.07	0.04	1.48			0.09	0.04	0.01	0.27	
80			0.11	0.22	0.65				0.07	0.04	0.12	
85			ND	0.17	0.16				ND	0.03	0.03	
90			ND	0.14	0.19				ND	0.03	0.03	
95		ND	ND	0.09	0.17			ND	ND	0.02	0.03	
100				0.16	0.21					0.03	0.04	
Cesium-137												
5	ND			0.02	0.01	0.68	ND			0.02	0.01	0.51
10	ND			0.02	0.02	0.75	ND			0.01	0.01	0.56
15	ND			0.03	0.01	0.67	ND			0.02	0.01	0.50
20	ND			0.01	0.02	0.74	ND			0.01	0.01	0.55
25	ND			ND	0.01	0.55	ND			ND	0.01	0.41
30			ND	0.01	ND	0.63			ND	0.01	ND	0.47
35				ND	0.02	0.26				ND	0.01	0.19
40	ND			ND	0.01	0.77	ND			ND	0.01	0.58
45		ND		ND	ND	1.15		ND		ND	ND	0.86
50		ND		ND	ND	0.49		ND		ND	ND	0.37
55				ND	ND	3.96				ND	ND	2.96
60		ND	ND	ND	ND	0.64		ND	ND	ND	ND	0.48
65			ND	ND	ND	0.21			ND	ND	ND	0.16
70		ND	ND	ND	ND			ND	ND	ND	ND	
75		ND	ND	ND	ND			ND	ND	ND	ND	
80				ND	ND					ND	ND	
85				ND	ND					ND	ND	
90				ND	ND					ND	ND	
95		ND		ND	ND			ND		ND	ND	
100				ND	ND					ND	ND	

Strontium-90

	Original Conc. (pCi/g)			5/30/95 (pCi/g)		
Depth (ft)	N-95A	N-80	N-103A	N-95A	N-80	N-103A
Date	9/1/94	7/1/92	4/1/92			
5	1.26	ND		1.17	ND	
10	37.80			35.06		
15	2.76			2.56		
20	14			12.99		
25	10.50			9.74		
30						
35						
40	1.22			1.13		
45		ND			ND	
50		25			23.33	
55			0.56			0.52
60		52	2.54		48.52	2.36
65			120.48			111.75
70		81	80.32		75.57	74.50
75		43	3.19		40.12	2.96
80			0.88			0.82
85			0.62			0.58
90						
95		2	0.41		1.49	0.38

ND - Not detected. Well number begins with 199-; 199-N-94A

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